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VIEWS, NEWS AND INTERVIEWS.

The Massachusetts board of railroad commissioners has refused to sanction the lease of the West End Street Railway Company to the Boston Elevated Railroad Company. The announcement caused a slight decline in West End stock, which later recovered.

A dinner was given by Peter A. B. Widener, the Philadelphia traction millionaire, on November 24, to a number of prominent Philadelphians at his residence at Broad street and Girard avenue. At this dinner Mr. Widener caused the announcement to be made through the medium of Dr. William Pepper, former Provost of the University of Pennsylvania and now president of the Free Library of Philadelphia, that it is his intention to bestow upon his native city the residence he now occupies. This residence was erected at a cost of $600,000, and contains furniture and art works valued at not less than $500,000. It is supposed that Mr. Widener intends to turn over his residence to the city within a period of six months. He has volunteered to spend the sum of $400,000 in fitting it up with books and works of art as a memorial to his wife, who recently died. It will be known as the Josephine Widener branch of the Free Library of Philadelphia.

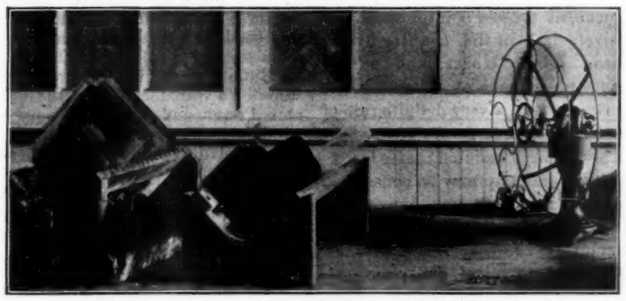
It was reported in New York city last week that the keen competition between the Western Union Telegraph Company and the Postal Telegraph-Cable Company may lead to a rate war.

A human ostrich is in trouble at Kansas City, Mo. He fears he has eaten too much door-knob salad and nail pudding. He has indigestion, and he has had the X rays turned on him to see what causes it. Responsible citizens say they have seen him eat tacks by the box and ten-penny nails by the pound. He has eaten several jackknife blades lately, and he thinks they are the cause of his pangs. At any rate, he wants to know where they are. The doctors will locate them for him, if possible.

At the recent inaugural meeting of the Roentgen society, in London, after the address by Prof. Silvanus P. Thompson, there was an exhibition of apparatus and photographs. In its account the *Times* mentions only two exhibits, both from America: "In the hall a splendid assortment of photographs was exhibited, perhaps the most striking being a life-sized skiagram of the entire skeleton of a full-grown living woman, taken by Dr. W. J. Morton, of New York. Apparatus for the production of Roentgen rays was also on view, the chief novelty being an electric oscillator, made and specially sent by Mr. Tesla, in the construction of which no thin wire is employed. When one of Tesla's own tubes is excited with this machine, the emission of Roentgen rays is so intense that, standing 50 feet away from it, one can still obtain on a luminiscent screen the shadow of the bones of one's hands."

The proposed Pacific cable between this country and Hawaii will be brought up before Congress this session. A bill was introduced in the Fifty-fourth Congress authorizing the Pacific Cable Company, of New York, to lay this cable. After being reported favorably by the Committee on Commerce in the House, it was sent to the Postmaster-General for a report. This report has not as yet been given out, but it is said will be presented to Congress soon after it assembles. Mr. Edmund L. Bayliss, vice-president of the New York company, has been in Washington looking after the interests of his associates. In an interview last week he said that the government had completed a survey of the route as far as the Hawaiian Islands, and if the bill passed at the coming session the cable would be in running order in 1898.

A floating paragraph says that the electric light at Penmarch Point, Brittany, called Eckmühl, is now nearly completed, and will probably be ready for use this Winter. It will be the most powerful ever constructed, having an illuminating power of 36,000,000 candle-power. The flashes, at intervals of five seconds, will be projected from two lenses coupled together, each consisting of four separate pieces. They will be mounted on a solid platform which rests in a trough of mercury, and will revolve around a vertical shaft. It will take 20 seconds to effect one revolution. This will be accomplished by means of a clockwork mechanism driven by weights. In each of these lenses will be an arc light provided with carbons of 10 and 16 millimeters diameter, thus enabling a large or small amount of current to be used. Alternating currents will be employed of 25 to 50 amperes, at a pressure of 45 volts. They will be generated by two two-phase alternators. In times of heavy fog both alternators will be set going, and together will supply a current of 50 amperes to each of the 16 millimeter carbons.



THE FAN MOTOR IN THE PHOTOGRAPHER'S SHOP.

The Fan Motor in the Photographer's Shop.

In photographic establishments of any considerable magnitude, the question of how to quickly dry the negatives after development has always been a serious one. A plate just from the washing tank requires ordinarily from four to six hours to become thoroughly dry, and on damp days often longer. Drying by means of artificial heat has been tried with more or less success and often with disastrous results where the film had not been previously hardened. One of Chicago's foremost engraving firms some time ago turned the ever useful fan motor upon a rack full of negatives, with the result that in from 10 to 15 minutes the largest plate was bone dry. Now, a number of these fans can be seen at work in the different departments, saving 90 per cent of the time formerly used. Our illustration shows a corner in the "stripping" room with the motor at work. It is a Western Electric fan motor, for the reason that it is said to produce the greatest amount of wind for the least expenditure in current.

Pittsburgh Bureau of Electricity.

The ELECTRICAL REVIEW has received "The Ninth Annual Report of the Department of Public Safety, City of Pittsburgh, for 1896." The report of Mr. Morris W. Mead, Superintendent of the Bureau of Electricity, is comprehensive, and shows that the work of the bureau has kept in step with the progress of electrical work with which it is concerned. The bureau has arranged to install a storage battery plant and has recently completed an underground conduit system. The patrol box telephones have all been placed on a metallic circuit system. During the year about 130 miles of wire were added to the system, making about 900 miles of insulated copper wire now in use.

It is reported that the American Express Company and the Knickerbocker Ice Company, in Chicago, will soon abandon their delivery trucks, now hauled by horses, and substitute for them electrically propelled wagons.

THE NEW MAXIM INCANDESCENT LAMP.*

BY HIRAM S. MAXIM.

In reply to your letter, I would say that all the reports that have appeared in the American and English Press regarding my experiments with electric lamps have come from a single source. An American newspaper reporter came to interview me. He said he had heard I was doing something with lamps. I said: "It is quite true that I am experimenting, but as yet I have no particulars to give. However, the lamp which is lighting this room, and which has displaced three 16-candle-power lamps, is 42 candle-power. When this lamp was made it was found to give a candle-power of considerably less than two watts, whereas the ordinary lamp takes at least four. I did not believe the lamp would last two hours; however, we put it on, and this was a long time ago, and the lamp is still running and is of great brilliancy and quite clean. If I were sure of being able to make lamps like this, in large quantities, the process would be worth a lot of money, but so far I have not advanced far enough to show the lamp to the public. I am running a number of lamps in a large room up-stairs, and some have been running 1,000 hours." As to the lamp in question, when it was put on it was 42 candle power; about two months later it was found to be 52 candle-power. However, it has commenced to go off, and when last tested was 41 candle-power, which would seem to indicate that it is not going to last for ever after all.

What I have been attempting to do is to produce a lamp in which a very high resistance might be obtained with a short and thick filament, also to produce a filament which will stand a higher temperature than those ordinarily used, as it is well known that a slight rise in the temperature greatly augments the light given in proportion to the current used, but the preparation of the carbon and other materials which form the filament requires a very expensive apparatus. The cost, however, of the finished filament—excepting first cost of plant—is no greater than with the ordinary lamps.

I have tested the new lamps in competition with all the best lamps I could find, and there is no question but what they show a very marked saving in electrical current, and this, of course, is the object aimed at after all. I have not decided as yet whether to keep the process a secret or to patent it.

The Production of Incandescent Lamps.

The incandescent lamp, simple in appearance, is yet very complex in all its features. Probably in no other branch of the electrical industry does experience count for so much; nor is there any product in which the best results are absolutely dependent upon constant, careful, continued inspection and testing. To secure a perfect product at the present low prices of lamps, both extensive experience and heavy production are necessary. The General Electric Company, with an output of over 6,600,000 lamps yearly, states that it is to-day manufacturing a better and more uniform lamp than formerly could have been procured for double the price.

So large a production and sale naturally allows of the adoption of many improvements. The Edison Lamp Works, at Harrison, N. J., are provided with a very complete laboratory, with a staff of competent chemists and electricians constantly occupied in carrying on experiments and tests, all tending to the betterment of the product.

Perhaps the most noteworthy improvement introduced during the past two years, is the new exhaustion process. By the adoption of this process the quality of the Edison lamp is distinctly improved. During recent years mechanical exhaust pumps, that is, pumps operated without mercury, have from time to time been presented, but in each case the size of the pump has been large, the object having been to exhaust a great number of lamps at one time. The Edison Lamp Works have succeeded in obtaining a small mechanical pump, with a rate of exhaustion such that it can practically be employed to exhaust one lamp at a time. It is now used to exhaust the Edison lamp, and the mercury pumps have been discarded. The final perfection of the vacuum, however, is not obtained by the pumps unaided.

In combination with these pumps a chemical process is introduced, exclusively used in this country by the Edison Lamp Works, and as the various phenomena of exhaustion are clearly marked, a very definite rule of operation has been formulated.

The natural residual gases of an incandescent lamp may be considered conducting gases, since they allow current to pass from one leg of the filament to the other. By the new method of chemical exhaustion all the residual gases are thoroughly removed from the lamp by the introduction of a gas capable of combining with them.

Previous to this introduction a blue glow fills the bulb when the filament is brought up to bright incandescence, but when the combination takes place between the residual gases and the new gas the blue glow suddenly disappears, and a lamp "sealed off" at this moment has, it is claimed, a vacuum of perfect insulating properties.

The advantages claimed for the chemical process of exhaustion are several. The combination of the gases in the bulb is a phenomenon said to be so marked as to furnish an absolute proof that the proper vacuum has been obtained. The lamps are exhausted one at a time, and the whole attention of the operator is concentrated on a single lamp. This, it is asserted, insures a perfection of vacuum difficult to obtain in lamps exhausted in groups.

*From the London *Electrician*.

The Niagara Falls-Buffalo Transmission.

The power transmission line from the Niagara Falls power-house to Buffalo has been increased, the demand for power from Buffalo having within the past few months grown beyond the capacity of the line first put up. The three wires strung on the poles have now three companions, and the white insulators on each pole have been increased to six.

A new order for cable as well as for transformers has been placed with the General Electric Company. The cable is of special manufacture, is insulated to stand the ultimate pressure of the line, which will be 22,000 volts, and is tested under a considerably higher pressure before leaving the works. Twenty-four thousand feet of this cable will be used at first for that part of the transmission line within the city of Buffalo. The order for increasing transformers covers seven of similar size and design to the three already installed in the transformer-house of the Niagara Falls Power Company. These 10 transformers are the largest ever built. Each has a capacity of 1,250 horse-power, making a total step-up transformer capacity of 10,000 horse-power. They are of the air-blast type, and will stand in rows of four upon the air-tight chamber, whence the air is forced through the ventilating spaces in the transformers. It will be remembered that the two-phase current at 2,200 volts passes from the 5,000 horse-power generators in the power-house to the transformers. In these, it is not only increased in pressure but changed in phase, the current issuing from the transformers three-phase current at 11,000 volts. This pressure will be adopted until it becomes necessary to increase it, when it will be doubled and be delivered to the transmission lines at 22,000 volts. On its arrival in Buffalo it will be delivered to the step-down transformers of the Cataract Power and Conduit Company, which controls its distribution there. The electricity will be transformed down to different pressures for distribution over a city network to different points for a variety of purposes, being used directly in induction motors, a number of which will probably be installed in grain elevators, etc.

Several step-down transformers will also be placed in the station of the Buffalo General Electric Company, and from these three phase currents, converted into direct current in rotary converters, will be utilized for lighting purposes and for small power units.

The Buffalo Railway Company is also increasing its step-down transformer and rotary converter capacity in its Niagara street power-house. In addition to the two 500-horse-power converters already in operation, the General Electric Company have built two others of similar capacity and construction. These will bring the total converter capacity in the station up to 2,000 horse-power. To supply these necessitates the installation of three additional step-down transformers in the transformer-house, between the station and the canal. These will be of about the same capacity as the three already there, each of 275 kilowatts, reducing three-phase current from about 10,500 volts to 375 volts for delivery to the alternating-current side of the rotary converters, in order that it may issue direct current at 550 volts, at which pressure it is delivered to the bus-bars of the station switchboard.

TELEPHONE NEWS AND COMMENT.

The Grafton & Canaan Center, N. H., telephone systems are to be united, making one line from Canaan Center to Bristol, via Alexandria.

The Canadian Government telegraph line has been extended along the northern coast of the Gulf of St. Lawrence, from Pointe aux Esquimaux to Aguanus, a distance of 80 miles, and offices have been opened at three points along this new extension.

The Western Electric Company has brought suit in the United States Circuit Court against the Capital Telephone and Telegraph Company, at Boston, Mass., asking for an injunction and damages on account of alleged infringements of a patented "multiple switchboard." The testimony has been taken and the case is on final hearing.

Telephone service has been put in between Lodi, Poynette, Portage, Briggsville, Baraboo, Reedsburg and Kilbourn City, Wis. F. E. Bell, of Portage, is at the head of the company, which has a capital of $25,000. About 200 miles have been built this Fall, and in the Spring connections with Madison will be made. The telephone headquarters are at Portage.

The Farmers' Telephone Company, of Southern Illinois, has been organized for the purpose of giving the towns of Jefferson, Marion and Wayne counties rival telephone connections. The new organization is a stock company, whose principal office is at Divide, in the northern part of Jefferson County, with N. J. Simmons, president. The company has secured a 20-year franchise in Mount Vernon. Work on the line between Mount Vernon and Divide will begin in a few days.

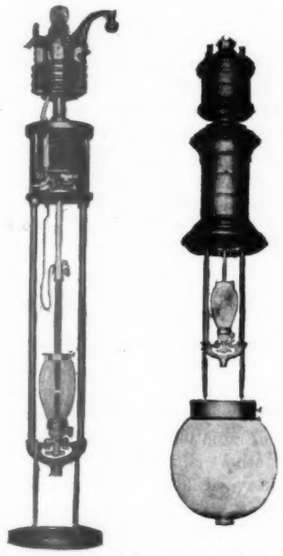
An interesting use of the long-distance telephone occurred a few days ago. A singer in Chicago had received an offer of an engagement with a New York concert company, and it was necessary to try her voice before the contract was closed. It was impossible for her to come to New York, so the telephone was utilized. She sang over the wire from Chicago and the experts in New York listened to her at their end of the line. It is said that there was no alteration in the tone or timbre of the voice during transmission.

The telephone industry in Sweden is a government monopoly, and is as complete almost as the postal system. The whole network includes at present 27,000 instruments, distributed over about 600 stations, while the population is about 5,000,000. There are only about 100 cities, leaving about 500 stations for villages and towns. With few exceptions, every city in the country is connected telephonically with every other, and there is scarcely a railroad town, or even a factory which can not communicate with any other in the country.

The Diehl Manufacturing Company's New Inclosed Arc Lamp.

The use of inclosed arc, or long-burning, lamps in modern electric lighting practice has become so general, and the advantages of this class of lamps are so thoroughly understood, that no mention of their merits is here necessary, the object of this article being a description of the latest and best type of this lamp to be placed on the market by the Diehl Manufacturing Company, of Elizabethport, N. J.

The illustrations show the general design of the lamp for indoor and outdoor use, and the method of lowering the outer globe and holding it in position while the lamp is being trimmed. The lower carbon-holder, to which the inner globe is rigidly clamped by a spinning, is securely held in a socket on the frame of the lamp, but it may be instantly detached, bringing with it the inner globe and lower carbon. This makes



FIGS. 1 AND 2.—DETAILS OF THE NEW DIEHL INCLOSED ARC LAMP.

it an easy and quick lamp to trim, reducing the breakage of inner globes to a minimum, and admitting of perfect alignment of the carbons.

The outer globe-holder screws into the bottom frame of the lamp, and not only forms a rigid support for the globe, but permits standing the lamp on end during installation or at any time when it may be necessary to take it down.

The cut of the mechanism shows its extreme simplicity. There are no gear wheels, pinions or springs. The magnets are firmly held at both ends, and two large dash-pots maintain a steady arc without flickering or jumping. The clutch is a particularly firm yet sensitive one, and gives to the lamp an almost imperceptible feed. There are no sliding contacts on the rack rod, the current being supplied to the upper carbon by a flexible cable.

It is impossible for a carbon to become jammed in the lower holder, as it is so designed that, by loosening one binding screw, the jaws may be entirely removed from the holder. This point will be found of the greatest convenience.

In case of breakage of an inner globe or bulb, a new globe may be inserted in the spinning already on the lamp, as the bulb is retained in the spinning by a binding coil. This obviates the purchase of a new spinning with every globe, and, when screwed down upon the lower carbon-holder, it forms an absolutely airtight joint.

The ornamental lamps are furnished in a number of special finishes, the ones most in demand being bronze, ebony, iridescent, oxidized copper, oxidized brass, dull brass with black bands, antique copper and gold lacquer, the latter giving an especially rich effect.

The plain, indoor lamps are furnished in lustrous black, but may be had in dull black finish instead, if so desired. All indoor lamps, whether ornamental or plain, are equipped with switch for turning the current on and off.

The Citizens' Telephone Company of New York and New Jersey.

The daily papers announced at some length last week the plans of the Citizens' Telephone Company of New York and New Jersey, which, it was alleged, would install an independent telephone system for Greater New York. It was said that exchanges of 50,000 subscribers capacity would be installed, and that the minimum rates would be $24 for business houses and $18 for residences.

A Mr. Edward K. Sumerwell was named as president of the new company. He was quoted as saying that "we expect opposition, and so I can not tell you how we intend to proceed."

Inquiry failed to discover the names of the capitalists interested in the project.

CHICAGO ITEMS.

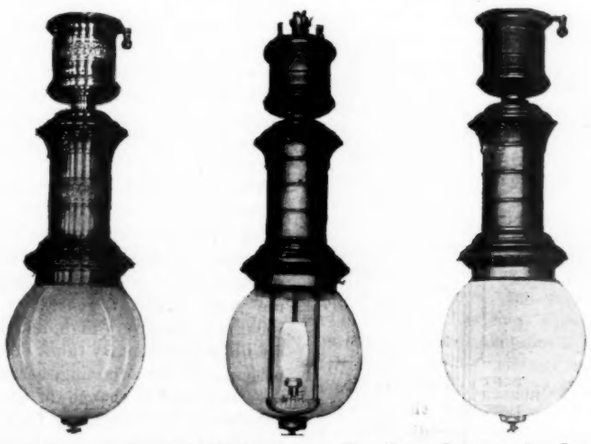
Mr. Osmer S. Burr, general sales manager of the Lynn Incandescent Lamp Company, was among the Chicago visitors recently, and reports a very gratifying condition of business in the West.

Messrs. W. D. Ball & Company, consulting engineers, say they have not been so busy for a long time as at present. Specifications for a number

FIG. 3—THE NEW DIEHL ARC LAMP, WITH REFLECTOR.

of large buildings are being prepared by them, and several lighting and heating plants are being erected under their supervision.

Mr. S. J. Wick, representing the Electric Railway Equipment Company, of Cincinnati, spent several days in the western metropolis last week, and is well satisfied with the result of his trip. However, it must be an easy matter for a gentleman with Mr. Wick's genial disposition and magnetic qualities to secure business in the electrical line.



FIGS. 4, 5 AND 6—DIFFERENT STYLES OF THE NEW DIEHL INCLOSED ARC LAMP.

Death of R. H. Rochester.

Roswell Hart Rochester, for many years treasurer of the Western Union Telegraph Company, dropped dead of heart disease while sitting with his family at his home in Englewood, N. J., at 10 o'clock on Saturday night, November 27. Mr. Rochester was a grandson of Col. Nathaniel Rochester, the Revolutionary soldier, legislator and judge, who gave name to the city of Rochester, N. Y. He was born in Rochester in 1838. He leaves a widow and one daughter.

Mr. W. J. McConnell, who for some time past has been representing our esteemed contemporary, the *Electrical Engineer*, in Cleveland, has opened a western office for that publication in Chicago, and being a journalist of long experience, with rather engaging manners, will, no doubt, in course of time secure a share of the western business.

Something new in switches would seemingly be hard to find, considering the thousand and one various devices already in use, but Messrs. M. B. Austin & Company are placing on the mark a push-button flush-switch that seems to contain features not heretofore combined in a device of this kind. The switch is made entirely of metal, glass and porcelain, the latter being used for the case only.

Mr. J. H. McGill, of McGill & Pomeroy, returned from a very successful western trip the other day, and speaks in high terms of the splendid business conditions prevailing. Among the many orders secured, he mentions particularly one for a lot of street railway material from the St. Joseph Railway, Light, Heat and Power Company, and another from the Sioux City Traction Company.

The advantages of the Union loop to the several elevated roads in Chicago can well be realized from the large increase in traffic on all the roads, especially the Alley L. This line is still showing a steady increase, the number of passengers carried the first three days of last week being 152,432 as against 142,101 for the corresponding three days of the preceding week, the average daily gain being 3,443.

With the nearing completion of the Northwestern Elevated Railroad, which will occur as soon as Mr. Chas. T. Yerkes borrows about $3,500,000 necessary to finish the work, residents of Wilmette and other northern suburbs are figuring on going to their offices in the city over the Union loop. This belief is caused by a change of route the Bluff City Electric line is said to contemplate. When this line first began to ask for franchises and ordinances, it was understood that connection would be made with the Chicago North Shore Electric line at North Evanston. But recently the property owners of Greenleaf avenue and Fourth street in Wilmette have been asked to sign a frontage petition for a route to the Llewellyn Park station of the Chicago, Milwaukee & St. Paul road. This is the terminal of the Evanston division of that road, and its officials have been figuring to "electrify" this branch. It is said that the new plans of the Bluff City Electric line contemplate the use of the Chicago, Milwaukee & St. Paul tracks to Sheridan Park, where the Northwestern "L" road ends, and where the Bluff City cars will connect with the "L" road. If these plans are carried out, Waukegan, Wilmette, Highland Park, Lake Forest, North Evanston, Evanston, Roger's Park, Edgewater and Argyle people will be able to ride into the business center over the Northwestern "L" and the Union loop. C. E. K.

Chicago, November 27.

Electric Mining Information.

The power and mining department of the General Electric Company has issued a handsomely prepared and finely illustrated pamphlet, entitled "Operation of Electric Mining Plants." Statistics are given showing that the General Electric Company has installed 75 electric mining locomotives aggregating 2,860 horsepower. A great deal of valuable information, derived from practical experience, is contained in the pamphlet.

THE WALKER COMPANY.

IT IS PURCHASED BY EX-GOVERNOR R. P. FLOWER, HON. ANTHONY N. BRADY, HON. J. W. HINKLEY AND HON. PERRY BELMONT, ALL OF NEW YORK.

The ELECTRICAL REVIEW announced last week the purchase of the Walker Company, of Cleveland, Ohio, by the four gentlemen named above. Additional details relating to the purchase come to us from Cleveland, through an authorized statement appearing in the *Leader*, of that city.

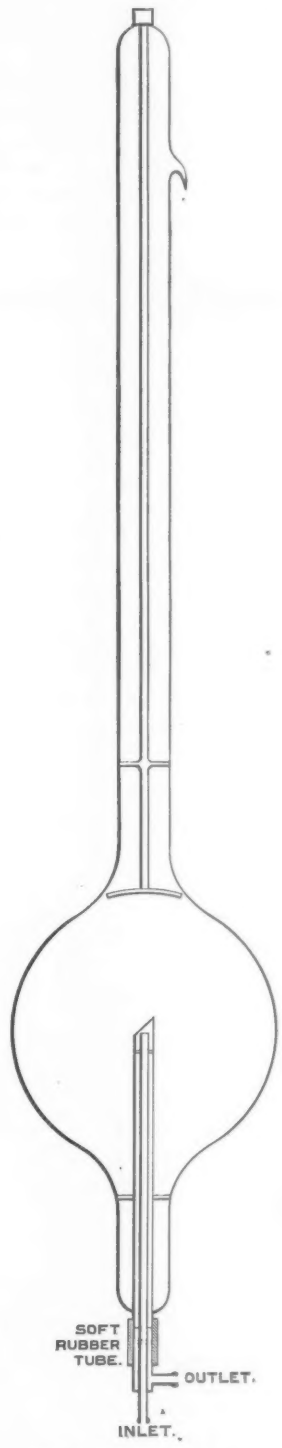
The transaction was consummated by correspondence, following a meeting held recently in New York city. The capital of the Walker Company is $2,500,000, and $1,500,000 of bonds have been issued. The capitalization and bonds are said to be about evenly represented in value by the assets. One of the principal owners was Mr. J. B. Perkins, of Cleveland, who had stock to the value, perhaps, of nearly $2,000,000. His interest, as well as that of the former president, Mr. Billings, is taken entirely. The stock of Prof. Sidney H. Short, the vice-president and electrician, is also taken, although he does not change his active relation to the company. The officers remain the same for the present.

All the stocks and bonds of the company, in four equal parts, have been bought by ex-Governor Roswell P. Flower, Hon. J. W. Hinkley, Hon. Anthony N. Brady and Hon. Perry Belmont, of New York. These men have for a short time past been stockholders in the company, although in a minority capacity. Now they have all. Their extensive ownership in electric railroads and electric lighting plants all over the country, and their wide connection with the most conspicuous financial powers in the nation, is of much significance to the future development of the Walker Company's business. A large foreign business is contemplated.

There are no present announcements to be made concerning plans for the future. Even larger equipment will, of course, come steadily, and the increase in the dimensions of the buildings as fast as demanded. The comfortable thing about the situation for the Walker Company is that whenever more money is needed it will be forthcoming at once and in any amount, virtually without limit, that may be desired. No increase of capitalization is at this time announced. Additional money might be put into the establishment without any increase of the nominal capitalization. The terms of the purchase are not known, and no one can judge of the value put upon the business and its properties by the owners, for Walker Company stock has never been upon the market to be quoted. So it has no financial statements to make. The valuable Short patents have never been included in estimates of the assets. The first thing that will be done in the way of enlargement will be a big extension of an already extensive business. The increase of facilities for gaining this have been indicated.

The officers of the Walker Company are Hon. J. W. Hinkley, president; Sidney H. Short, vice-president, and F. W. Ferguson, treasurer. Mr. Ferguson, the new treasurer, is from the East, and has won a large circle of Cleveland friends since his arrival.

The factory buildings of the Walker Company, in Cleveland, cover 12 acres of ground on the shore of Lake



THE A-W-L X-RAY TUBE.

Erie. The tracks of the Lake Shore & Michigan Southern Railroad pass the works on the north, and Waverly avenue bounds the property on the east. It has works also at New Haven, Ct. There is a division of work between the two factories, so that the lighter equipment, like switchboards, are made in New Haven, and the heavy machines in Cleveland. The company is incorporated under the laws of New Jersey.

The A-W-L X-Ray Tube.

TO THE EDITOR OF ELECTRICAL REVIEW:

As the X-ray tube described in the ELECTRICAL REVIEW for November 24, 1897, has attracted some attention, I venture to describe it more in detail. The tube is of the so-called focus type, in which the cathode rays impinge on a platinum anode, the surface of which is placed at an angle of 45 degrees with the long axis of the tube. To admit of the use of a long spark I make the distance between the terminals much greater than in the present tubes. If a spark of 15 inches in air is used, the distance between the terminals should be 20 inches, and about this proportion should be maintained in using longer sparks. The center of the anode surface should be in the focus of the cathode at the degree of vacuum at which the tube is sealed.

This has before been impossible, as the anode would quickly be destroyed by heat, even with the moderate currents now used. The anode has always been placed beyond the cone of the cathode rays, resulting in a large radiant point, and making the best definition impossible. For financial reasons the anode is short, the necessary length of the tube between terminals being obtained by extending the cathode stem. The hollow platinum anode, sealed in, has a tube inside, as shown in the diagram.

One end of this tube is connected with a reservoir of water, a fountain syringe bag, for example, and the supply, regulated by a stopcock, is maintained of sufficient volume to keep the water dripping from the outlet tube, so that it feels cool to the finger when the tube is pushed to the capacity of the generator. A small flexible rubber tube attached to the outlet serves to conduct away the waste water. If air is used, the inlet pipe is attached to one end of a rubber tube, the other end of which is connected with a small air compressor operated by the motor operating the generator.

The inner tube is not permanently connected with the anode, the joint being a bit of rubber tube; it may therefore be made of cheap metal. As these tubes are intended only for use with powerful generators, the vacuum is made very high, and there are no supplementary tubes or other useless parts for adjusting, because it does not readily change in use. A tube which has been in use for a considerable time gives as powerful effects as a new one, for the glass does not blacken easily. Owing to their good definition and penetration, they are particularly adapted to difficult medical diagnosis, and were designed for that purpose.

The objection to these tubes is their first cost, due to the amount of platinum, but as I have found by experience that the same anode can be used again, this objection is not very serious. Moreover, I shall later figure a modification of the same principle which is cheaper to construct.

WILLIAM ROLLINS.

BOSTON, Nov. 25.

GOLD FOIL SCREENS IN X-RAY PRACTICE.

MR. J. ELLIOTT WOODS DEFENDS HIS EXPERIMENTS AND TELLS OF OTHERS HE HAS RECENTLY MADE.

TO THE EDITOR OF ELECTRICAL REVIEW:

I deem it a fitting time to supplement a previous article on this subject by a description of the production of an X-ray burn and its interesting development. I do this because it bears directly on the question of a protecting screen described by me in the ELECTRICAL REVIEW for September 15, 1897. I realize, however, that after the declaration of an eminent experimentalist who, without (according to his article) making a trial of this screen, states his disbelief in the efficacy of gold foil, my efforts as an amateur should retire into oblivion. An experiment of his is quoted to "offset much that Mr. Woods has said." I confess to no small stagefright in again entering into publicity, but I beg of you to bear with me until I get through with a few more statements which I hope may not be wholly uninteresting.

In the first place, the experiment quoted as a part of the argument against the protecting power of gold foil, in X-ray exposures, was substantially this: Professor Thomson placed pieces of foil on his finger, leaving a small portion bare and exposed to the action of the rays. He received burns under all except tin foil. Why he did not under this is evident, because ordinary tin foil is capable of stopping a large percentage of radiation. Why he did under the others is, according to my first article and later experiments, also evident. The account of his experiment shows no action taken to carry off the electrical energy which any foil is most certain to absorb. I think a reference to my article will show that I deemed it vitally important to connect the protecting screen to the earth.

Even if Professor Thomson had taken these precautions, it is doubtful whether, with the small lead plate he used to cover other portions of his hand, he would escape entirely. In my belief, it is necessary that the screen be large enough in area to protect the body from the entire angular radiations emanating from the usual type of focus tube. By experiment I have found that when the screens are small and a large portion of the body is left exposed to the radiations—no matter if it be remote from the particular portion under test—a considerable charge of electricity may be absorbed, and the results may vary. To explain this I will say that, starting from screens 10 by 10 inches, increasing in size to 30 by 30 inches—all used being connected to earth—it will be found that the electrical charge imparted to, and which can be taken from, the body will vary greatly. It will generally be found, when the screens are used as I use them, near to the tube, that the an-

gular radiation from the bombarded spot on the platinum is about covered by the larger screen. At this point no charge can be drawn from the body of the person under examination. I am still of the opinion that this charge, imparted to the body, whether it be directly given by the energy emanating from the discharge tube, or whether it be caused as in condenser effects, by the body taking to itself a charge of opposite sign, is an important factor in the production of these X-ray burns. Figs. 1 and 2 will diagrammatically indicate the reasons for employing large screens earth connected.

The final proposition to which I have come is this: A screen made of gold foil of the purest character, laid on cardboard in two layers, is prepared. The size is three by three feet. This is set in a wider screen made of two upright pieces six feet apart, and the setting is made centrally and at about the convenient working height of the tube. All that portion of the large screen not occupied by the gold foil screen is covered with canvas on which is laid ordinary lead foil. The gold foil and lead are connected, electrically and finally, the lead foil through a wire to a convenient gas or water-pipe to the earth. The entire outfit is then suitably placed about six or eight inches from the tube, which will be understood as occupying a position centrally with respect to the gold foil screen. Behind a gold foil screen, earth connected and of the size named, I have placed patients for examinations made by surgeons in this city, and in about all of the cases the actual exposure to the rays averaged an hour and one-half, and these examinations were made at an average distance from the tube of twelve inches. In some cases the screen was placed as close as two inches from the tube and limbs of the body pushed close up against the screen. I have yet to hear of an injury received by either of the patients examined.

It will be remembered that in my previous article little detail was given other than that certain symptoms were obliterated by the interposition of the screen used. For this reason Professor Thomson could not see that I had clearly stated my case. He could not have failed to note the purpose of the article and the cautious intention certainly shown in my remarks. I asked no one to believe me, but to try for themselves, as I proposed to try further. At that time the procurement of a powerful focus tube and the completion of the gold-foil screen were synonymous. I did not know the actual power of the tube except by the bodily sensations of heat it produced and the action of its energy through the body as viewed on the fluorescent screen. But immune as I had been I was afraid of it, and never used it for more than five minutes except under the protection of the gold-foil earth-connected screen. Professor Thomson's letter appeared shortly after my letter, and at a time when I was carrying on experiments. I have awaited the result of these experiments before "rushing into print." Avoiding a great amount of detail relating to the experiments referred to, I will give only the one which, in my opinion, is sufficient to help Professor Thomson to a clearer understanding of my faith in gold-foil screens.

A screen was provided having in its center a one-inch round hole. Through this hole the rays could pass without hindrance. The screen being duly connected to earth was placed on my arm with the hole centrally over my forearm. The tube was the one which, in conjunction with the screen of gold leaf, was used in the prolonged surgical operations before referred to. I desire particular attention to the fact that the state of the vacuum was arranged the same as in those operations.

At a distance of 12 inches between arm and tube an exposure of 20 minutes was made. When the screen was removed and the clothing turned back, a pink spot of the exact size of

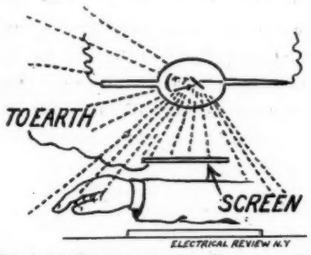


FIG. 1.—A SPARK FROM THE BODY CAN BE OBTAINED IN THIS CASE.

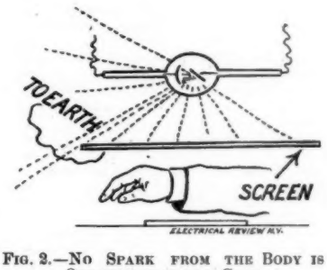


FIG. 2.—NO SPARK FROM THE BODY IS OBTAINABLE IN THIS CASE.

the hole in the screen disclosed itself on the skin. The screen was then prepared, by closing up the hole with the necessary number of layers of gold foil, electrically connected, of course, to the remainder of the screen, and another exposure of 30 minutes was made in a different location on the same arm. I think I could barely detect the result, but it disappeared so quickly that I had to depend largely on imagination to locate the effect. To-day is the twenty-ninth day since this particular exposure was made. Not the slightest effect shows from the exposure made through the gold foil. Now as to the exposure made through the uncovered hole.

For about 10 days the pink spot continued to grow deeper in color. A slight tingling then set in, lasting perhaps a week, finally causing me some annoyance by severe itching. The outer skin turned dark brown and loosened. There was no blister, no extension of the inflammation beyond the clean-cut outlines which marked the size of the screen opening. Then this well marked spot begun to make things lively for me, and, for a few days, the affected place raised up above the arm surface like a washer. The outer crust came off, showing beneath a disagreeable looking sore, fully an eighth of an inch in depth. To-day, the twenty-ninth since the exposure, I consulted my physician for its future treatment. I beg to repeat the statement that, when the exposure was made with the hole in the screen properly covered with the foil, the whole being in connection with the earth, absolutely no harm has resulted.

Further, I wish to add that when a screen is properly made with, say, two layers of pure gold leaf, such as gilders use, the absorption, if the screen be passed before a fluorescing screen, is so little that I have scarcely been able to notice it.

In some experiments made with this perforated screen, I have got strong effects on the skin in three, four and five-minute exposures. In one case, I raised a small blister on the finger by exposing only six minutes. In each of these experiments, I have always checked, by another and equal exposure, closing the perforation in the screen, as described, and shifting the location, usually making the exposure at closely lying points. For clearly evident reasons, I have used the tube operated in the long exposures before referred to, wherein patients have been behind the screen for an hour and a half. For the same reasons, the vacuum was kept at a certain standard rating.

Still, I will not say that with prolonged exposure one could not be burned behind such a screen. I still maintain that an intimate knowledge of the apparatus should be acquired. One should not consider how long a patient can be kept under the rays, but how brief can the exposure be. It is hard to explain how this knowledge can be acquired. It seems to be a question largely of personal judgment. As I have experimented with the most powerful tube obtainable, I can give only my personal experience. This I will say: With the degree of vacuum used and the power supplied by a 12-inch spark coil, the exposure necessary for a hip joint photograph ought not to be more than 20 to 30 minutes, and for the chest about 15. The hand, arm and shoulder I have easily taken in 30 seconds, three minutes and 10 minutes respectively, using the tube referred to. These are large figures for the power I used and most of the plates show an over-exposure.

Of the 20 odd experiments, carefully planned and earnestly and faithfully executed, I have given in detail the most important one. The comparison I have made in the two uses of the perforated screen; the added description of the surgical uses to which the large and developed screen has been put; all these justify my faith. An exposure of very long period through the gold screen might burn, but if we have in such a screen a protection in necessary and reasonable exposures, we surely have accomplished something. We must still leave to the surgeon-operator the question of exposure—whether it shall be reasonable or criminal as many have made it so. With a good fluorescing screen as a guide I do not see how a careful surgeon can be misled.

Before I close, I desire to add my firm belief in the opinion expressed by Professor Thomson relative to the possible variation in wave lengths of the energy sent out from an X-ray tube. I have commenced a series of experiments based on the theory that we are dealing with a new form of electric energy. It may still be the "X ray." There are some remarkable results to be obtained and I hope, judging from some already secured, to comprehend a few more. I trust that the near future will enable me to detail a few for the thoughtful consideration of your scientific readers.

ELLIOTT WOODS.

Washington, D. C., November 5.

ELECTRIC LIGHT FLASHES.

J. A. Newbauer has been appointed receiver for the Montpelier, Vt., Light and Power Company.

The Palmyra, Mo., electric light and water plant has been sold at sheriff's sale for $11,200 to Lilburn G. McNair, of St. Louis.

The Pasadena & Los Angeles, Cal., Electric Company is about to add a new boiler and generator to its power plant, to cost about $38,000.

There is talk of starting a stock company to furnish electric light for McGrawville, N. Y., at a cheaper rate than at present prevails.

The city of Houston, Tex., will soon vote upon the proposition to issue $100,000 of municipal bonds, to be used in erecting an electric lighting plant, to be owned and operated by the city.

The Consolidated Electric Lighting and Power Company, which supplies Kansas City, Kan., with its electric lights, is contemplating building a new power-house, which will be about twice the capacity of the present plant on North Fifth street. The site of the new structure will be on the west bank of the Kaw River, near the new Metropolitan power-house, and the building will be of brick.

The Butte County, Cal., Electric Light and Power Company has elected the following directors: Robert A. Friedrich, Samuel J. Hendy, Oscar T. Weber, Joseph Simonson and Richard White. The directors elected the following officers: Robert A. Friedrich, president; Joseph Simonson, vice-president; Samuel J. Hendy, treasurer; Oscar T. Weber, secretary; J. W. Hartzell, general manager.

The directors of the United States Electric Lighting Company, of Washington, D. C., has elected officers as follows: President, A. A. Thomas; first vice-president, James L. Norris; second vice-president, Thomas O. Mills; secretary, Seymour W. Tulloch; treasurer, W. A. Mearns; cashier, E. S. Marlow; executive committee, Messrs. Thomas, Norris, Hills, W. H. Slater and Charles Werner; auditing committee, Geo. W. Gray and Samuel J. Butterfield.

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CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

NEW YORK, DEC. 1, 1897.

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The adoption by the Metropolitan Street Railway Company, of New York city, of the underground trolley system, for practically all of its surface lines and the great improvements being carried out all over its system, indicate a far-sighted management, which must eventually result in large financial profit to the stockholders of the company. It is stated that the company can now show that its average rate per passenger is lower than three cents per mile. This low rate has been arrived at through the company's excellent and far-reaching system of transfers.

Dr. William Rollins, of Boston, describes in this issue of the ELECTRICAL REVIEW a new form of X-ray tube which he has devised for use in connection with surgical diagnosis. Dr. Rollins has been an earnest experimenter in X-ray work and has developed a number of improvements of considerable value to the medical profession.

On another page of this issue of the ELECTRICAL REVIEW will be found a very interesting account of some further experiments in the protection afforded by a gold foil screen in preventing X-ray burns. The communication is signed by Mr. J. Elliott Woods, of Washington, D. C., an account of whose previous work in the same line has already appeared in the ELECTRICAL REVIEW. Mr. Woods still has faith in the gold foil screen in spite of adverse criticism, and makes the very common-sense remark, that even if the screen will not prevent burns under indefinitely long exposures, it still affords a means of protection for short exposures, which are those most commonly used.

PUBLIC TELEPHONE PAY STATIONS.

It is generally admitted that the telephone service is becoming day by day a more important factor in both commercial and social life in large cities, especially where the residence and business districts are widely separated. For instance, the new city of Greater New York contains about 4,000,000 inhabitants, some of whom live on Staten Island and some of whom live in the Borough of the Bronx. These two localities are at least 17 miles apart. It is important, of course, that these people have means to communicate with each other. The fact that they appreciate this necessity is shown by the constantly increasing demand for public telephone pay stations in the territories of the New York Telephone Company and the New York & New Jersey Telephone Company. As is generally known, these pay stations place the entire telephone system of Greater New York within reach of the general public. In the more thickly settled portions of the greater city, especially in the business sections, it is rarely necessary to walk more than one block to discover the sign of the "blue bell," indicating a public telephone station. The establishment of these stations is dependent entirely upon the public demand, and their constantly increasing number is the best proof that social and business intercourse can not in these days be carried on without their aid.

THE MAYOR AND THE RAILWAY MANAGER.

He of the famous battle axe, Mayor Patrick J. Gleason, of Long Island City, N. Y., who attends street railway conventions and drinks champagne for breakfast, got into a scrap one day last week with General Manager Beetem, of the New York & Queens County Railroad Company. The clash occurred because the city Water Department cut off the water supply from the power plant of the railway company in the Astoria section of Long Island City. The Mayor said the railway company was in arrears for water taxes. Mr. Beetem hustled around and soon had three immense water tanks engaged in bringing water from Newtown. When the tanks arrived at the power-house they were pumped out and returned for a fresh supply. The Water Department in the meantime was engaged in digging up the railway tracks of the company for the ostensible purpose of making a change in the water mains. When Beetem learned of this he ran a trolley car over the excavation, took his stand on the front platform, and warned the workmen that if they molested the property of the railway company they would do so at their peril. The workmen dug up to within about a foot on each side of the tracks and stopped. A warrant was sworn out for Mr. Beetem, and as he stepped off the platform of the car he was arrested by two policemen in plain clothes. One of them he knocked down. The other policeman informed him that he was under arrest and he submitted. He was released later in the custody of his counsel Thinking that the city officials might carry the matter further, Mr. Beetem provided several hundred feet of fire hose, which he attached to a pump in the power-house. Had the Water Department insisted on going on with the work Mr. Beetem would have defended his property with a stream of hot water, which would undoubtedly have been effective. The matter has now got into the courts, and is still in abeyance. Trust an electric railway manager to overcome obstacles!

It is interesting to note the rate at which the exports of electrical apparatus from the United States is growing. In a little more than half a year the value of these exports has amounted to $2,000,000, representing an increase of about $500,000 over the figures for the corresponding period of last year. Exporters state that the foreign demand for electrical apparatus is continually growing stronger.

Wall Street and the Electrical Stock Market.

The event of the week in electrical-financial circles was the consummation of the purchase of the Walker Company by ex-Governor Flower, A. N. Brady, Perry Belmont and others. These capitalists have been interested in the Walker Company for some time, and are fully cognizant of its value as a money-earner. The most suggestive feature of the arrangement is the connection of these capitalists with various street railway and industrial properties, which is certain to result in turning over to the Walker Company a large volume of business. Moreover, they are in close touch with financial interests in this center who control the other large electrical manufacturing corporations. August Belmont, for example, is a director in the Westinghouse company. It is regarded as probable that the Walker people will work in harmony with both the General Electric and Westinghouse.

Electric street railway shares continue to grow in investors' favor. In the so-called outside market quotations on various stocks and bonds of these properties can now be obtained without difficulty. A few are listed on the Stock Exchange. The Metropolitan Street Railway came into notice with a sharp advance during the week, due to a phenomenal increase in October earnings. There is talk of greater profits yet to accrue through the operation of the Fourth avenue line, which is now in part being run by the underground conduit system. Coincident with this increased demand for Metropolitan Street Railway shares was a revival of talk of a deal with the Manhattan Elevated, whereby the two companies would be operated under practically one management. There are many in Wall street who believe that such coalition will be the ultimate solution of the New York rapid transit problem.

A well posted specialist in electrical securities says that he is in possession of data which warrant the statement that during the first half of 1898, provided the market is at all receptive, there will be an unusually large number of stocks and bonds of electrical enterprises offered to the public. He says that the development has been steady for several years, and the purchase of new equipment is now unusually heavy. Since the 1894 business panic there has been comparatively few attempts to sell securities. They have been held back until an opportune time. He believes the supply will be sufficient to meet any demand which is likely to exist, and does not look for anything more than fair prices, which he says would be on a basis of a few per cent under par for a five to six per cent first mortgage security.

The Akron Street Railway and Illuminating Company, which last week offered a certain number of its bonds to the public, as outlined in this column, has called a meeting of stockholders for December 18 to vote on a proposition to merge Cuyahoga Falls Rapid Transit Company into the Akron company. The merger is dependent upon the success of the bond issue. The lien of the bonds will be extended to cover the Cuyahoga rapid transit line in case the deal goes through.

It is stated that the Western Light and Power Company, of Chicago, has been purchased by the Chicago Edison company for about $300,000. It operates in the old town of Lakeview, has a 1,200-horse-power light plant and an unlimited franchise, and earned net, for nine months ending September, $11,021.

The stock of the Walker Company is divided into shares of $100 each; $2,500,000 bonds are authorized, of which $1,500,000 have been issued.

Electrical securities followed the course of the general market, and up to the closing day of the week showed very little activity. Final prices were about the best. General Electric fluctuated within a narrow range, and the close was 32¼. There has been a quiet absorption of stock by small investors in discount of the excellent business which the company is known to be doing. It is argued that the stock sold a year ago at present prices, when business and prospects were not half as good. I understand that transfer books will show that there is considerably less stock in speculative channels than there has been for some time since the business depression and attendant liquidation. Bell Telephone dropped from 264 last Saturday to 259 on Friday, and to-day was unsettled. Erie Telephone is unchanged at 70, New England was 126 bid and 128 asked. There was practically no feature in Pennsylvania Heat, Light and Power or the other electrical stocks at Philadelphia.

P. S.—There is a rumor to the effect that the Walker and Fort Wayne companies are likely to unite.

BAIN.

Wall Street, November 27.

Postal Telegraph Ship News Service.

On Friday the cable-laying steamer "Mackay-Bennett" completed the placing of a cable connecting Coney Island and Sandy Hook. Two ends had previously been placed and buoyed, one from the "hut," the building in which terminates the ocean cables of the Commercial Cable Company, and the other from Sandy Hook. It is the plan eventually to have a connecting link between Fire Island and the Highlands, and this will give a splendid marine news service.

A large party of guests were aboard the steamer, among whom were Charles Cuttriss, chief electrician of the company; C. F. Cutler, president of the New York Telephone Company; U. N. Bethell, general manager of the New York Telephone Company; Colonel Ludlow, of the Engineers' Department, U. S. A.; Geo. T. Manson, of the Okonite Company; Chas. H. Wilson, of the Southern Bell Telephone Company, and A. B. Chandler, president of the Postal Telegraph Company.

LATE NEWS.

Cars on the new underground trolley system on the Madison avenue line in New York city began running last Sunday on regular schedule between 135th street and Astor place. They had been in operation between Forty-fourth street and Astor place for some time.

A syndicate of capitalists, all Baltimore men with the exception of John E. Searles, the sugar magnate, has purchased a controlling interest in the Boulevard Electric Railway, between Baltimore and Washington, for $2,500,000. It is expected that cars will be running before Spring.

Alexander Brown & Sons, of Baltimore, Md., representing a syndicate of Baltimore, London, New York, Philadelphia and Pittsburgh capitalists, have consummated the purchase of all the stock of the United Traction Company, of Pittsburgh, amounting to $20,000,000, of which $3,000,000 is preferred stock and $17,000,000 common stock. This will give them control of the largest street railway system in Pittsburgh and Allegheny, owning and operating 117 miles of electric lines.

Receiver Jump, of the Terre Haute, Ind., Electric Railway Company, has filed a report showing the total indebtedness to be $1,338,517, but of this amount $250,000 consists of bonds issued as collateral security for some of the floating indebtedness. The receiver has not made a report of the inventory of the property, because some of the machinery was purchased conditionally and is not fully paid for. There is also said to be due to the Terre Haute company from $5,000 to $11,000 from the Michigan City Trolley Company, of which Mr. Russell B. Harrison is president. The receiver's petition for authority to borrow $25,000 to buy boilers and enlarge the capacity of the street railway and electric lighting plant was allowed by the court.

American Electrical Journalism.

There are said to be no less than 58 monthly and weekly journals devoted exclusively to the electrical industry. Of these, 15 are published in France and 11 in the United States, while the others are scattered all over the world. It goes without saying, of course, that the American electrical public is better served journalistically than any other. American journalism, as a whole, is more enterprising and up to date, and these characteristics naturally extend to special fields where technical journals are carried on by men formerly connected with daily newspaper work. It is safe to say that the files of any two of the older American electrical journals will be found to contain a complete history of the electrical art since its inception.

PERSONAL.

Col. S. G. Booker, of the Phœnix Carbon Manufacturing Company, St. Louis, is visiting New York city.

President James F. Cummings, of the Armorite Interior Conduit Company, was among the visitors to New York city last week.

It is announced that Prof. Elihu Thomson will contribute a number of articles on applied electricity to the *Youth's Companion* during 1898.

Mr. Paul W. Bossart has resigned the secretaryship of the American Electric Telephone Company, of Chicago, and has accepted the position of general manager of the Pennsylvania Electric Company, of Marietta, Pa. This company will engage in the manufacture of magneto bells, telephone receivers and a general line of electrical goods. In Mr. Bossart they have secured a capable and experienced telephone man and electrician, well equipped for the responsibilities of the work intended.

Testing Edison's Iron Ore.

[*From the Pittsburgh Times.*]

While the big furnaces of the Carnegie company have been making new records at Duquesne, up at Dunbar another experiment is going on that is destined to have its effect on the production of iron and steel in the United States. The Dunbar furnaces have been trying the ore separated from low-grade rock by Edison's new process, and it has proven so satisfactory that 1,700 tons of the ore have been ordered. The Edison ore practically enjoyed the benefits of separation before it was loaded on the cars, for the electrical process is designed to remove the ore from the rock with which it is associated. Hence, when it comes to be shipped from the ore banks to the furnaces, the waste has been eliminated, and the ore alone is transported. Naturally, an ore that carries with it so little waste means a great difference in freight costs.

Pacific Cable Company.

The stockholders of the Pacific Cable Company, of New York city, have elected as directors J. Pierpont Morgan, Edmund L. Baylis, J. Kennedy Tod, John Irwin and James A. Scrymser.

The company announces that it will lay a cable line to Hawaii within 18 months, and that plans have been prepared for 9,000 miles of cable, running to Japan, China and Australia. The company will have close business relations with the Mexican Telegraph Company, the Central & South American Telegraph Company and the Western Union Telegraph Company.

A New York man is said to have invented a "safe" acetylene gas lamp which has only two drawbacks—the light can not be turned down except very slowly, and the light can not be turned out and the lamp left standing. In the latter case gas will continue to generate and escape from the lamp. Another step forward in acetylene progress!

MUNICIPAL OWNERSHIP AND OPERATION OF STREET RAILWAYS.*

BY P. F. SULLIVAN.

(Concluded from page 267.)

"In the cities of Europe, millions have been spent on the quays and docks. Take, for example, the magnificent Victoria embankment on the Thames at London, the quays of the Seine at Paris and the embankment on the Neva at St. Petersburg. Few American cities have been willing to improve the water fronts properly. If our water fronts were improved, economically and carefully, they would meet with the general approval of the intelligent citizen, but so many large cities are cursed with ring rule that the suggestion of a general system of stone embankments and docks (either on bays or rivers) arouses universal objection and indignation.

"Several years ago a dishonest contractor was constructing a sewer near Central Park, in New York. He was in great haste to obtain his money, and, instead of using pipes, he laid barrels in the ground, for which he received the contract price."

"As I write, municipal officers of all grades in many of the large cities are now under indictment, and many more would be added to the list if it were not for corrupt police magistrates, packed grand juries and negligent attorneys."

("Municipal Reform in the United States, by Thomas C. Devlin.")

"The science of municipal government in this country is crude. Our methods are expensive and our governments inefficient. The burden has become oppressive, and nearly every city in the land is making some efforts for reform, and there are no cities where the same are not necessary."

"That there are able and well meaning men in all these reform movements no one will question, but there are also 'sore-head' politicians who nourish the rancor of defeat, and harebrained theorists who have never had one practical thought in matters of personal interest."

"In summing up the shortcomings of American cities, it has been very easy to make comparisons with European cities and to suggest the adoption of the same principles of government and methods of administration under which those cities have been made models of efficiency and economy. It is, however, the opinion of those who have studied most carefully the municipal problem in the United States that no material aid can be had from the adoption of European methods in matters of city government."

"The matter of franchise is one of the most distinguishing features between American and European city governments, and which in a measure renders the adoption of European methods impractical. All the powers of government in Europe are in the hands of the property-owning class. In Germany, the three-class system of voting, while affording the masses a pretense of power, gives to the wealthier classes absolute control of municipal affairs. A study of the franchise in American cities shows that the non-taxpaying voters are a large majority. Taking Boston, for instance, the registered vote of Boston in 1892 was 73,000. There were 32,407 taxpayers, of whom 3,200 were women having no vote and about 700 aliens or non-residents. Deducting the taxpayers who are non-voters, leaves 28,507 as the number of property-holding votes out of a registered vote of 73,000. If every taxpaying voter voted, this shows the non-property vote at 46,693, against a property vote of 28,507."

It is said that cities are business concerns in which every taxpayer holds an interest, and there is a persistent demand that its affairs shall be conducted on business principles. Then it seems not unfair that representation in the city should be limited, as in a business corporation, to the stockholders, if the same results are desired. If this hypothesis is correct, we must admit that no business would succeed under management similar to the cities. It is also true that the ignorant, vagrant and purchasable element comes almost wholly from the non-taxpaying class, and their only interest in an election is the price they may receive for their votes. They are an element of especial solicitude to the ward politician, and are often the decisive power in partisan contests. Indeed, it may be further said that integrity, honor and ability will never prevail, in city councils particularly, until the candidates may safely disregard the demands of the worst elements of society and know that their election depends upon citizens who hold those virtues to be their chief qualifications.

Every large city is practically in control of the non-taxpaying element, and from this class the intemperate, vicious and purchasable vote is mostly composed, and it is through his influence with them, and his ability to handle them, that the ward politician secures his own election and achieves success for, and standing with, his party. He is often one of this party which he controls, and if not, affiliates with them, which amounts to the same thing. He extends to them, so far as he can, the same patronage which he and his colleagues in other wards have received from higher authority. He promises the creation of new offices, clerkships in others, and jobs in parks and streets without number, and thus crowds every department of the public service with incompetency and unworthiness, which would never be tolerated in any private enterprise. Through all the avenues of patronage he looks forward to paying campaign obligations and of maintaining his prestige with the party. Surely the alliance of the business of cities with national politics, and its control by the party machine, is a serious evil. It opens the way for every form of dishonesty and mismanagement which avarice and ambition can suggest.

The power of the legislature to meddle in city affairs is corrupting both to the legislature and the city. The city "professionals" will be in attendance at each session of the legislature, and when the city charter is acted upon, or special acts concerning the city are passed, they will be marked by their cunning and avarice. The Hon. Seth Low tells us that in every year of his term of office he was compelled to oppose at Albany, the seat of the state legislature, legislation seeking an increase in the pay of policemen and firemen, without any reference to the financial ability of the city or the other demands upon the city for the expenditure of money. * * * New and useless offices were sought to be created, and the Mayor found that not the least important of his duties as Mayor was to protect the city from unwise and adverse legislation on the part of the state. Edward W. Bemis, writing in *Public Opinion*, says: "A recent chief of the Chicago Sanitary Department assured the writer that there were not six of his hundred subordinates whom he could trust. It was useless to dismiss any one, for the chief must take in his place whomsoever some alderman may desire." Not infrequently new offices with chiefs and many deputies are created for no real purposes other than the positions they offer. The pay is often out of all reason for the service rendered, but it is expecting too much of human nature to hope for any change while the system which makes it possible prevails. To cut off the salaries or positions of one's friends who labored during the long siege of an election campaign, requires a degree of courage and ingratitude not attainable by the average councilman. Francis G. Peabody, in comparing municipal service in the United States with service in the cities of Germany, says: "With us municipal offices are the spoils of successful politicians; in Germany they are the prize of experts. It seems to a German as incredible to hear of a city governed by men who are just pausing on their way to some higher place as it would be to hear of a railroad or of a cotton mill thus superintended. Good city administration with us is an accident."

The advocates of municipal ownership point with pride to the postal service of the United States, and would have us infer that in all things the national and municipal governments could do likewise. In this they speak as partisans, yet we should not deny them such comfort as they may get. They do not refer to the annual pension appropriation, now $150,000,000 per annum, nor to the fact that the late General Grant and the late General Garfield, both good authorities, stated that $40,000,000 would be amply sufficient. They do not refer to the river and harbor appropriations, of which the late President Arthur wrote in one of his veto messages, "as the measure (river and harbor bill) became more objectionable it would secure more support." They do not refer to the National Government's experience in Union Pacific or to the experience of the State of New York in the Erie Canal.

STATE OWNERSHIP OF RAILROADS.

The experience of France and Brazil with government ownership of railroads is not encouraging to the advocates of the idea that railroads should belong to the people at large, and should be operated by officers appointed by the government. The South American republic has determined to abandon state ownership of railroads, after a thorough test of the theory, and is now negotiating with European capitalists for a lease of the entire system, comprising 14,000 miles of track. When Brazil took charge of the Central Railroad that corporation had paid as high as nine per cent dividends, but under government control it has not only failed to earn its expenses, but has cost the people $2,000,000 or $3,000,000 a year above its receipts. The experiment of state ownership of railroads has been tried longer in France than in Brazil, and under more favorable conditions. The model road there runs through well populated districts, with large cities as terminals; but the results in France are discouraging. Eighteen years ago a railroad system was constructed which was to furnish cheap rates for passengers, cheap freight for shippers and abundant profit for the state. It has done none of these things. At first the advocates of the enterprise insisted that only time was required to prove the wisdom of the project. Eighteen years have passed and the results may be briefly summarized. Theoretic methods have been abandoned, and the railroad is now managed substantially as are those in the hands of private capitalists, except its tariff of rates is a little higher, and its cost of operation is considerably larger. The last report shows that the net return on the whole capital expended is $1\frac{35}{100}$ per cent, and even the state can not borrow money for less than three per cent. The government has every year a considerable deficiency to settle, and the people who use the line pay somewhat more than they would have done if the enterprise had been left to private capital.

Canada has had an experience of state ownership also, but upon a more limited extent. There the government owns about 10 per cent of the whole, upon which it loses about $500,000 annually. The railroads and their equipments and fares of France and Germany operated by the government can not be compared with those of England operated by private capital; and the manufacture of tobacco and cigars by the government of France has produced such vile stuff as to be an object lesson to enthusiasts of government monopoly.

PUBLIC OWNERSHIP AND PRIVATE OPERATION.

Some of the advocates of changing the present state of things stop short at the operation of street railways by the municipalities and advocate that the municipalities own the tracks and lease them to private capital. They are aware of the present condition of our administration and dare not go to the logical length of their position. If our municipalities are so unbusiness like and corrupt in their methods as to be incapable of operating a street railway property, then they are also unfit to manage the construction of the property and to make contracts for its use. You can not stop half way. The motive for public ownership abroad is twofold. The first has reference to the conditions of the streets and street surface. They have, as a rule, finely constructed and maintained streets, and in their very proper regard for keeping them so, they desire to control all construction and maintenance of tracks. The second has reference to controlling and regulating the method of operation. That has proven a failure, and can be accomplished better when granting a franchise. In nearly every case in England where the municipality has acquired the operation of the property it did so involuntarily.

The city of Toronto, Canada, is the only instance in America of public ownership and private operation. The conditions and contract there please the theorists and the street railway company, and all are happy. While I am neither a prophet nor the son of one, I will state that, in my opinion, before the contract period shall have expired, Toronto will have cause to regret that it adopted some English methods under almost American conditions. The municipality constructs the concrete bed for the tracks, supplies and does all paving, and removes all plowed snow. The compensation which it receives per mile of track is much less than that paid in some states by one company for running over the tracks of another company. Percentage of receipts, rates of fare, etc., should be looked upon as nothing more nor less than a premium for which the operating company receives a monopoly. Competition and the fear of it are completely shut out. Single fare and transfer carry a passenger only to the suburbs. Those going to and from the suburbs pay extra fares, and as the city grows in population, it will become as congested as foreign cities, or the people will be compelled to pay extra fares to get to and from suburban homes. Such conditions exist nowhere in the United States. The conditions with respect to To-

*Read before the American Street Railway Association, Niagara Falls, N. Y., October 22, 1897.

ronto and its suburbs suggest a practical problem in the United States, should municipalities desire to acquire street railway properties. Usually abroad, street railway systems are operated within the limits of the municipality, as at Toronto. Should the systems be extended further, additional fares are charged. In the United States, on the contrary, in nearly every instance the street railway system extends beyond the city or town limits, and usually only a single fare is charged. Should a city obtain the street railway system within its own jurisdiction an interesting problem is opened with respect to the owner of the balance of the property; and in case the balance of the property should be acquired by the other towns through which the system may be operated, as to divisions of "spoils," profits and losses. It may result as it did in Birmingham, England, in the price of gas. That city provides its own gas, and charges suburban towns 50 per cent more than it charges its city consumers.

A Protest From Dr. Hachenberg.

To the Editor of Electrical Review:

In the Electrical Review of October 6 is an article on Heilmann electric locomotive. Without going into the merits of Heilmann's invention, I would respectfully ask you to compare it with mine, published in the Review August 29, 1894, under the heading "General Electric Railroading."

This is not the first time I have been robbed of the credit of my invention recorded in your valuable journal.

In another instance, in a paper published in the Review March 20, 1895, "How to Make Safes Burglar-Proof," the electric part of it, its main feature, was applied by some inventor for the same purpose. His name and the date of his paper I don't remember. Yours truly,

G. P. Hachenberg, M. D.

Austin, Tex., October 20.

A Commercial Travelers' Fair.

A commercial travelers' fair will be held in the Madison Square Garden, New York city, from February 28 to March 5, 1898. The fair, in just the measure that it proves successful financially, will help to complete a national home for disabled commercial travelers and their dependent families and the widows and orphans of commercial travelers. The incomplete building stands on South Mountain near the city of Binghamton, N. Y. The officers of the commercial travelers' fair are: President, Chauncey M. Depew; vice-presidents, Governor Frank S. Black and Mayor William L. Strong; secretary, R. G. Dun, and treasurer, Mayor George E. Green, of Binghamton. Mrs. T. C. Platt is the chairman of the women's committee, and Van Schaick & Norton are the counsel.

All the suburban lines of Ohio show an increase for the month of October. The gross earnings of the Akron, Bedford & Cleveland for October were $10,050, as against $7,260 for last year. The Cleveland, Painesville & Elyria's earnings were $8,360, as against $7,030 for October, 1896.

TWENTY-FIVE YEARS' PROGRESS IN INCANDESCENT LIGHTING.*

BY J. W. SWAN, F. R. S.

(Concluded from page 248.)

Another line of technical progress is in the durability and the keeping up of approximately the original efficiency. Modern lamps of the best make do not blacken as the primitive lamps did. I do not mean that there is absolutely nothing further to be desired in that respect, because it is still possible to darken even the best modern lamp by subjecting it to a voltage greatly in excess of that for which it was made. I mean that this fault has been much reduced, and even rendered trivial, and I believe that finality in this direction has not been reached.

Coming to the line of commercial progress, it will be remembered how utterly unprepared the world was in 1880 to take immediate advantage of incandescent lighting. The then existing dynamos were few, small and inefficient; there were no central electric supply stations. The bold experiment in electric current supply from a central station, initiated by Mr. Edison, in New York, did not instantly demonstrate that incandescent lighting was capable of being turned to profit. The results had to be waited for, and other experiments of the same kind as that at New York had to be tried before the commercial soundness of electrical distribution from a central station became established, and no great progress was possible until this point had been reached. The time pending this was the most critical period in the history of electric lighting.

The Paris Electrical Exhibition of 1881 had given a strong impulse to commercial enterprise in connection with electrical undertakings. Public expectation as to the capabilities of electric lighting was at the highest pitch, and there was blind faith in the great possibilities of electrical achievements—a faith that, in the long run, has happily been largely justified by the event, but that was quite unreasonable in its excessive optimism and want of allowance for the time necessary for the provision of means to ends. Over-sanguine and not always over-scrupulous adventurers took advantage of this frenzy of innocent faith, and in attempting to realize the impossible, failed; much money was thrown away on useless or premature enterprises, and public confidence was rudely shaken. This check was unfortunately accentuated by unwise legislation, which, by placing the fruits of enterprise almost out of reach, well nigh paralyzed it. But if in consequence of these drawbacks progress was slower, it was also surer. It gave opportunity for working out innumerable necessary details and improvements in the matter of the dynamo, cable laying, current distribution, and pressure regulation, and for the designing of suitable and appropriate lamp fittings, switches, cut-outs, voltmeters, ammeters, supply-recording meters and a host of other things; the ultimate result being that fewer and less serious mistakes have been made than would have been inevitable if the pace had been much faster.

Meanwhile, valuable tentative advance was being made through the lighting of steamers, theaters, detached residences, factories and hotels.

The improvement made in the storage of electrical energy unquestionably gave material assistance to the introduction of electric lighting in the earlier stage of its progress. There was then prevalent a great dread of the failure of the current and the extinction of the lights; so much so, that often gas fittings were left in their old place, and were even made a part of new installations as a safeguard against this danger. The secondary battery met this. It did more; it steadied the pressure in the case of small installations driven by gas engines, and provided a supply of current after the engine had stopped.

Whilst the mechanical engineer was making common cause with the electrical engineer, and they were groping their way to those triumphant results which have since been arrived at by their united efforts, and whilst all the complicated problems of electric current distribution were in process of practical solution, the manufacture of the incandescent lamp has gone on in a continual and steady progress, both technical and commercial, till now. There is no longer any question either as to the excellence or the economy of incandescent lighting, and none as to the public demand at a profitable rate for the supply of electric current; the progress latterly has become increasingly rapid, and a prospect is opened out of immense expansion. How far that expansion may extend it is impossible to forecast; but the imagination may be assisted by a computation made by one in close touch with the commercial side of the lamp industry, that, at the present moment, the number of lamps in use in different parts of the world expressed in the eight-candle-power equivalent is probably not less than 50,000,000.

* From the London *Electrical Review*

ELECTRIC RAILWAY NOTES.

The Sydney, New South Wales, street railway systems are owned by the government, and at present represent about every kind of mechanical traction yet tried, there being 67 miles of steam dummy road, nine miles of cable road and three and one-half miles of electric road.

A company has been formed to build an electric railroad from Marshfield station to Brant Rock, Mass., and then down Duxbury beach to the Duxbury line, a distance of six miles. The capital stock of $50,000 has all been paid in, and the well known business men of Brant Rock are among the directors.

L. V. Walkley, who held a controlling interest in the Southington, Ct., & Plantsville Tramway Company, which operates a line of electric cars between Southington and Plantsville, has transferred his controlling interest to Ralph P. Ives, who has been manager of the company for the past seven months. The company is capitalized for $20,000, and bonded for a like amount.

The annual statement of the Cornwall, Ontario, Street Railway Company, just issued, shows a total year's business of $25,282.68, made up as follows: Passenger receipts, $16,557.35; freight, $1,661.47; other sources, $7,063.80. The operating expenses were $20,172.81, the items being salaries, repairs, fuel, snow sweeping, insurance and sundries. The bond interest was $2,500, and the account interest $1,200, leaving a net profit of $1,359.87. The capital stock of the company is $150,000, and it has in the treasury $33,800. The vice-president, in his report, considers the outlook very satisfactory.

OUR CANADIAN LETTER.

Champbellton, N. B.—An electric light plant is required here.

Yarker, Ont.—E. W. Benjamin will put an electric light plant in his factory.

North Bay, Ont.—A new power-house will be built by the electric light company.

Greenville, Que.—This town offers a first-class location for a pulp-mill and electric light plant.

Fort William, Ont.—Steps will be taken at once to construct an electric light system. Specifications will be prepared by Geo. White-Fraser, of Toronto.

Weston, Ont.—The rate-payers are talking of fire protection. An electric light and power company, with a capital of $3,000, is being organized.

Port Dover, Ont.—Tenders are wanted for lighting the village of Port Dover with electric lights or gas. For particulars apply to R. M. Taylor, clerk.

Hamilton, Ont.—The Electrical Power and Manufacturing Company have asked the city to grant them permission to supply electric light and power throughout the city.

Darmouth, N. S.—The town is considering the question of purchasing the electric light plant. It is probable that at an early date improvements thereto will be carried out.

Toronto, Ont.—The rate-payers will be asked to vote on two questions—first, as to whether they favor the construction of a civil plant for lighting streets and public buildings; second, as to whether they favor an electric plant for commercial power and lighting purposes.

Hamilton, Ont.—The Cataract Power Company, of which Hon. J. M. Gibson is president, has closed a contract with the Royal Electric Company, of Montreal, for the electrical apparatus required for the development of the water-power of De Cew Falls. The scheme will include the building of a canal from Allanburg to the power-house, a distance of four and a half miles, the contract for which has been let to Angus McDonald & Co. The canal will be from 40 to 45 feet wide.

Montreal, Que.—The Royal Electric Company has received a handsome contract from the city of Fort William. This is for apparatus and machinery necessary for the construction of an electric lighting plant at that place. The contract price is $13,000, and it is expected that the Royal Electric Company will be able to complete it in two months' time. The city will do its own lighting.

The Royal Electric Company has also made recently a contract with the town of Maisonneuve for street and residential lighting for a period of two years. J. A. C.

Montreal, November 25.

The Local Harrison Telephone Company, of Toledo, Ohio, has gone into the hands of a receiver.

SAFE CURRENT CAPACITY FOR ELECTRICAL CONDUCTORS.*

BY C. E. SEWALL.

It is the purpose of this paper briefly to discuss the general physical laws and conditions which bear upon the subject.

One of the old rules for determining safe current capacity was that of Clark, Ford & Company, English wire manufacturers. It allowed 10 pounds of copper per mile for each ampere of current. Translated into familiar terms this means that No. 18 Brown & Sharpe carries two and one-half No. 6-42 and No. 0000 338 amperes. I will put them opposite the figures of national code for same sizes:

	R. C. Wires.	C. F. & Co.	W. P. Wires.
0000	2.0	(338)	312
6	46	(42)	65
13	3	(2½)	5

Taking averages for all conditions, this ancient rule of thumb is not so far out of the way for those sizes with which the early manufacturers were familiar.

Subsequently the British Board of Trade established the rule of 1,000 amperes per square inch of cross-section. Here is the comparison with code:

	R. C. Wires.	B. T.	W. P. Wires.
2,000,000	1,050	(1,570)	1,670
1,000,000	550	(785)	1,000
4/0	210	(166)	312
1/0	127	(83)	185
6	46	(21)	65
14	12	(3¼)	16

In March, 1884, Prof. Geo. Forbes read a paper before the London Institution of Electrical Engineers, in which he exhibited mathematical calculations showing the number of amperes necessary to raise wires of given diameters to certain temperatures, and also calculations as to the effect of insulated coverings. He pointed out that the Board of Trade rule, 1,000 amperes per square inch, was uneconomical for small conductors; and actually unsafe for those of large, though perhaps unusual, diameters.

Mr. A. E. Kennelly read before the Edison Convention at Niagara Falls in August, 1889, a description of a series of experiments furnishing a great amount of reliable information. He did not, however, make experiments nor calculate tables upon the stranded conductors that are generally used when larger than 0000 Brown & Sharpe is required; and as the conditions in stranded conductors are quite different from those in solid ones, there was still uncertainty as to the proper current for large leads.

In November, 1896, Mr. Merrill, electrician for the Chicago Board of Fire Underwriters, made experiments in a station of the Chicago Edison Company, the results of which were issued in his laboratory report No. 523, and are now published (with unimportant differences) as part of the code.

The maximum temperature to which a conductor may be raised must be limited by several considerations.

1. Heat increases the resistance of conductors.

2. Heat decreases the resistance of dielectrics.

3. Some kinds of dielectrics, notably rubber, will soften at high temperatures and permit the metal to sink into them, bringing it nearer the surface of, or possibly quite through, the insulating covering.

4. The temperature may rise to such an extreme as to cause a conflagration.

In 1886 a committee of the London Institute of Electrical Engineers reported the following rule:

"The conductivity and sectional area of any conductor should be so proportioned to the work it has to do that, if twice the current proposed be sent through it, the temperature of such conductor shall not exceed 150 degrees Fahrenheit."

If 150 degrees Fahrenheit is the maximum limit, it is hardly possible to better the rule. It is supposable that no one will object to a factor of safety of two. The writer knows of one instance where, under very careful experimental conditions, a fuse that had been long in service successfully resisted current of twice its rated capacity.

As a starting point, Mr. Kennelly thought that 75 degrees Fahrenheit represented a fair average condition, and his experiments are built up from that point. It was assumed that the temperature would increase as the square of the current strength. That being the case, a current sufficient to increase the temperature 18 degrees Fahrenheit (to 93 degrees) would, if doubled, raise it four times 18 degrees, or to 147—and just within the committee's danger line.

As Mr. Kennelly's figure for a fournaught insulated wire, run in moulding, is 175 amperes, and the new code gives 210, then the rise in temperature under the latter figure will be as 175 squared (30,625) is to 210 squared (46,200); and, as the former rise was 18, the latter will be 28, and, doubling the current, we shall have 112, or a maximum limit of 187 degrees. But 75 degrees is not the maximum condition. It is conceivable that, on a July day, paneled wires may be surrounded by a medium showing 100 degrees Fahrenheit, and it seems fair to suppose that, if double the current in amperes given in the present code should be sent through a wire in the condition indicated, its temperature will be raised to 212 degrees.

Temperature limitations in an electrical conductor depend upon:

1. Electrical conductivity.
2. Extent of radiating surface.
3. Nature of radiating surface.
4. Nature and condition of surrounding medium.
5. Specific heat of metal.

Extent of radiating surface depends, first, upon form. A thin, flat strip having the greatest, a round, solid wire the least. A stranded conductor has, for the same ohmic resistance, a larger circumference than a solid one, and its surface is corrugated. Approximately the distances around these forms, counting in all curves in corrugations are as follows:

Circle	8.27	linear inches.
Strand.....	12.22	" "
Cable.....	14.14	" "
Bar.....	22.73	" "

and their radiating surfaces for equal lengths are in that proportion.

Roughened surfaces will give off heat faster than polished ones. If thoroughly blackened, the co-efficient of radiation is twice that of a polished surface. If covered with a black insulating covering, radiation will be still further promoted. Professor Forbes's calculations showed that the greater surface obtained by applying an insulating covering more than compensated, up to a certain thickness of coating, for the poor thermal conductivity of the insulator, and this was borne out by Kennelly's findings. Two of the latter's curves disclose the fact that a rubber covered wire with an insulation 73 mils thick had a temperature elevation 30 per cent lower than that attained by a wire of the same diameter, but only covered to a thickness of 11 mils. From the tests the evidence was distinct that the effect of an insulated covering was to cool the wires; *i. e.*, if the covering was black; wire wound with white cotton was found to be higher in temperature, with the same current, than a bare one.

For a gutta-percha covering it is supposed that radiation will be better than with rubber. Professor Forbes makes the proportion of thermal conductivity as 48 to 41 in favor of gutta-percha as compared with rubber.

It is also highly probable that a conductor with an ordinary wall of insulating material incased in lead will bear more current than if protected by rubber or gutta-percha alone. Mr. Fisher, of the Standard company, placed upon a wooden floor four cables running side by side in the form of an elliptical spiral. Unfortunately, full data are not given, but the calculated tables from the experiment show, for a rise in temperature of 25 degrees, about the same figures as the National Code, and as the cables lying side by side must have heated one another, it is a fair inference that their radiating properties under even conditions are rather better than for unleaded wires. Undoubtedly cables suspended in air will carry much more than the code allows. If under ground, much will depend upon conduit ventilation.

After heat has been brought to the surface of a conductor, and is radiating therefrom, it causes the particles of air in its vicinity to move away and to be replaced by others which are again moved and replaced, and so on. This process is called "convection."

The experiments of 1889 showed that a No. 10 Brown & Sharpe bare copper wire in a room from which drafts of air have been carefully excluded will be raised in temperature 18 degrees Fahrenheit from 75 degrees Fahrenheit by 26 amperes, and will require 42 amperes to bring it to the same temperature if the wire be suspended out of doors upon a calm, Summer day.

In a room guarded against outside drafts the agitation of a fan near a current-bearing wire sensibly decreased its temperature elevation.

The influence on radiation from convection and from color also may be seen by grouping figures from experiments for No. 0000 Brown & Sharpe gauge under four different conditions, viz.:

Bright bare copper in a room with still air, 162 amperes.

Blackened bare copper in a room with still air, 200 amperes.

Bright bare copper out of doors, calm weather, 322 amperes.

Blackened bare copper out of doors, calm weather, 340 amperes, starting with the same temperature elevation and attaining the same rise.

The influence of extent of radiating surface is shown by comparing code allowances for the same cross-section, first in one conductor, No. 0000 gauge, 210 amperes; second, in two conductors of one naught gauge, 254 amperes, 21 per cent increase.

The percentage increase from one 2,000,000-circular mils conductor to two of 1,000,000 circular mils each is from 1,050 to 1,300 amperes, or nearly 24 per cent.

It may be convenient to remember that with large conductors there can be gained from 20 to 25 per cent in cooling effect by making a lead of two conductors of one-half the cross-section required, instead of using one conductor with the whole cross-section required.

While convection is not directly proportional to radiating surface, it seems to be to length, and Mr. Kennelly gives as an approximate rule that in still air the loss of energy due to convection has a mean value of 0.00175 watt per linear centimeter for each degree centigrade of temperature elevation, or one kilowatt for every 114 meters at 50 degrees centigrade temperature rise.

Different quantities of heat are required to raise the temperature of a given weight of different substances a certain number of degrees. This is called specific heat. For the reason that the specific heat of iron is 25 per cent greater than that of copper, we may expect to find that iron wires safely carry more current than is indicated by their compared resistance with copper for the same cross section.

For metals other than copper, I have been able to find but little information. Mr. Preece in 1888 furnished very complete data on fusing effects, but as these involve the capacity of the metal to resist melting they are not reliable guides to effects of moderate heat. In a catalogue issued some years ago there are tables for carrying capacity of iron. These give for the equivalent in cross section of No. 10 Brown & Sharpe in galvanized iron wire a maximum safe current of 12 amperes, the wires being placed in a wood frame (whatever that is). For tinned wires $12\frac{3}{10}$ amperes. These figures are about one-half the code allowance for the same size rubber-covered copper wire. The resistance given in the same table ($8\frac{1}{2}$ times that of copper) indicates a low grade, electrically, of iron wire.

In the same book, German silver, No. 10 Brown & Sharpe, having a resistance of $16\frac{2}{3}$ times greater than copper, is allowed a safe carrying capacity of $8\frac{5}{10}$ amperes. The 18 per cent German silver wire usually found in the market of to-day has a resistance 18 times that of copper.

No further explanations as to conditions, etc., accompany the table just mentioned.

It is a law that the temperature of a conductor increases as the square of the current strength if the resistance is constant. As temperature rises resistance increases; but it is also the fact that greater activity in radiation and convection tend to offset the effect of higher resistance, and experiments have shown that in a wire which is given a fair chance to part with its heat the rule approximately holds good for an indefinite time.

For the same reasons and under the same conditions, with a given rise in temperature, the square of the current varies as the cube of the diameter of a round wire.

The law governing safe temperature of a round wire is expressed by the formula $C = a\,d\,3/2$, where C is the proper current in amperes, d diameter, a the constant which is applied to suit conditions under which the wire is to be used. Kennelly's constant for insulated wire in moulding is 560, if d be in inches.

A solid No. 0000 Brown & Sharpe is .46 inch diameter. That figure raised to the 3/2 power is .312. $.312 \times 560 = 174.72$ amperes, which was for a long time the underwriter's rule for No. 0000.

As the limit has been raised to 212 for rubber-covered wires, it follows that the present constant is $212 \div .312$, or 680 (nearly), and for weather-proofed wires $312 \div .312$, or 1,000.

For stranded conductors let us consider a familiar size, 500,000 circular mils, which, by the latest catalogue, Roebling's, is of a diameter .819. For ease in computation call it .82

*Abstract of a paper read before the Chicago Electrical Association, November 5, 1897.

(for neither stranding nor carrying capacity are as yet exact sciences) (.82)3/2 is .742. Code amperes for 500,000 circular mils are 390, which, divided by .742, gives 526 as the constant for rubber-covered strand. A similar process will show 600 to be the constant for weatherproof strand.

It will be noted that the constants for stranded conductors are smaller than for solid ones.

This is because the diameters for strands are larger, in proportion to resistance, than for solid ones.

Previous to issuance of the present code, the only rule as to stranded wires that I was able to find was given in an English publication by Mr. Stuart A. Russell on electric light cables. Speaking of Kennelly's constant for solid wires (560), he said: "When stranded conductors are used, it must be remembered that their resistance is about 28 per cent greater than that of a solid conductor of the same length and diameter, owing to the loss of space in stranding, and therefore the formula given must be modified so as to take this into account. It is evident that the same amount of heat will be generated whether the current C is passed through a resistance R, or a current $\frac{C}{\sqrt{1.28}}$ is passed through a resistance $\sqrt{1.28}\,R$; and, therefore, for stranded wires the constant 560 must be divided by $\sqrt{1.28}$, making the formula $C = 500\ d\ 3/2$."

Acting upon this suggestion the writer, some years ago, calculated a table for strands. Apparently English manufacturers made their strands smaller in diameter than the Americans, and my constant figured 487 instead of 500. But it was questionable whether air in the interspaces of a strand would not so retard radiation as practically to counteract effect of larger outside surface.

Mr. Merrill's results have demonstrated that there is a counteracting influence for the constant of 487, corrected by results of experiments, becomes 434 for a limiting current of 174 amperes for 0000 (the old rule).

It is probable there is neither gain nor loss so far as heating effect is concerned by making conductors in concentric strands. This is corroborated by an examination of the published code. We find that a 200,000 circular mils stranded conductor is allowed 200 amperes, or one ampere per 1,000 circular mils and that a No. 0000 solid conductor of 211,600 circular mils is allowed 210 amperes, or very nearly in the same ratio. There may be advantage in using the cable form, but it is doubtful.

Professor Forbes at one time seriously proposed the use of flat strips for underground conductors, but he overlooked the fact that large surface means great increase in cost of insulation. In those days the wires were buried in the ground without the use of conduits, a condition very unfavorable to active convection. We can all remember that but a few years ago conduits were not ventilated except as the manhole covers, from time to time, acted automatically.

All data so far given in this paper are based upon the action of direct current. There can be no doubt but that the heating effect of alternating current, especially in large conductors, must be considerably greater than if direct current is used.

FIG. 1.—GEAR PLANT OF GENERAL ELECTRIC COMPANY AT LYNN.

FIG. 2.—INTERIOR OF GEAR PLANT, SHOWING GEARS READY FOR SHIPMENT.

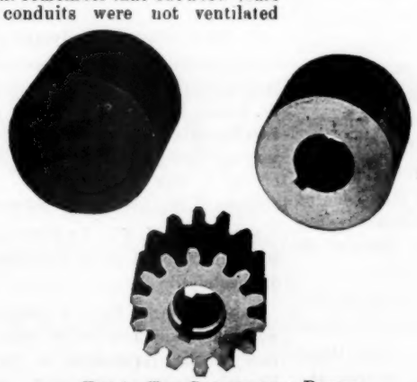

FIG. 4.—THE GROWTH OF A PINION.

A Modern Gear Plant.

The astonishing growth during recent years of the electric street railway industry, has led to an equally rapid development in the manufacture of gears for use with railway motors. Railway motor and motor gear and pinion are coeval, but during the life of the motor many sets of gears and pinions are necessary. To-day, when the number of motors in use reaches well toward the hundred thousand, the demand for gears and pinions is enormous, and at no time in the past has it reached its present proportions. A mild estimate places the number of electric railway motor gears in daily use, in the United States alone, at 50,000 at least, and as the average life of the gear is about two years, a yearly output of from 20,000 to 30,000 is necessary for renewals alone, exclusive of those required for new motors.

In the pioneer days of the electric street railway, the cast-iron gear and pinion of gun-metal were used exclusively. Experience and time necessarily brought about improvements and changes. To-day the standard motor gears are of cast steel and the pinions of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast iron to steel has resulted in a reduction of some 60 to 70 pounds in the weight of the gears, while their life has been very materially increased. A steel gear will wear more than twice as long as a cast-iron gear, and while with the latter type breakage was a common occurrence, with the steel gear breakage is practically unknown.

FIG. 3.—DRILL PRESSES, MILLING MACHINES, ETC., IN GEAR PLANT.

To supply gears which would carry in themselves a guarantee of perfection, the General Electric Company established some time ago, at its River Works, Lynn, Mass., a plant for the manufacture of gears and pinions. This plant is a model of its kind. The cutting machinery is of the most modern character, and the entire plant is laid out on a comprehensive scale. The exterior of the establishment is shown in Fig. 1. In this building is an extensive foundry for the gear blanks, as well as the gear-cutting shop. The former is equipped with overhead traveling cranes, driven by electric motors, furnaces for the molten metal, core ovens, and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings—the tendency to secure blowholes, draws and cracks—has been overcome in this foundry. After a long series of experiments, the General Electric Company perfected a process which now enables the foundryman to produce steel castings which are as practically perfect as if of hammered steel. Indeed, it may be said that in this gear foundry the manufacture of sound steel castings has reached an extremely high state of development, for not only has the question of soundness secured practical perfection, but the strength and wearing qualities have been the subject of long experi-

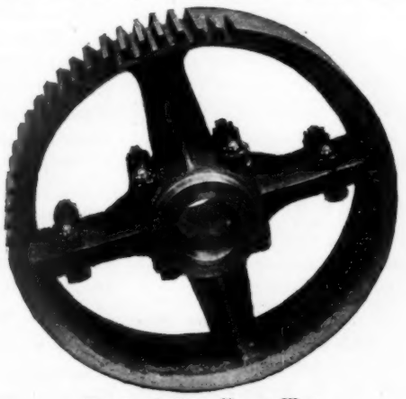

FIG. 5.—A GEAR UNDER WAY.

(Concluded on page X.)

ADVANCE INFORMATION

New Telephone and Telegraph Companies.

RALEIGH, N. C.—The Dunn & Lillington Telephone Company has been incorporated, with a capital stock of $5,000.

SOUTH PITTSBURGH, PA.—The East Tennessee Telephone Company have let the contract for putting in local telephone exchange.

EMMETTSBURG, MD.—Claude and Harry Manning contemplate establishing a telephone system.

BEEVILLE, TEX.—A telephone exchange is to be established.

SHELL LAKE, WIS.—The Wisconsin Valley Telephone Company contracts have been let for construction.

OWOSSO, MICH.—The State Telephone Company expects to have its line in operation here within a week.

ALLENVILLE, ILL.—J. J. Downey and C. E. Pope applied to the City Council for a franchise to operate a telephone system in this city.

CORYDON, KY.—A telephone exchange for this place is being talked of.

ROCKPORT, TEX.—The Rockport & Gulf Coast Telephone Company has been incorporated by S. B. Sorenson, A. L. Bruhl and E. A. Stevens, for the construction and maintenance of a telephone system throughout the city of Rockport. Capital stock, $2,000.

PORT JERVIS, N. Y.—The Port Jervis Telephone Company has been incorporated to operate a telephone system in and between that place and Deerpark. Capital stock, $4,000. Directors, John P. Van Etten, of Conashaugh, Pa.; William L. Cuddeback, Moses Depuy, Samuel H. Gariss, J. Wallace Gordon, Fred Mason, William A. Parshall, Charles E. Reuling, William E. Scott, John T. Van Etten and Philip G. Wagner, of Port Jervis.

UNION, ORE.—The extension of the Union Telephone Company's system from this city to Baker City has been completed.

CHATTANOOGA, TENN.—The telephone line is being extended from Lewisburg to Globe, by way of Duncanville and Mooresville.

ST. LOUIS, MO.—The National Telegraph and Messenger Company has been incorporated with a capital stock of $2,000. William R. Knox, J. F. Carr and P. White incorporators.

ALFRED, N. Y.—A new telephone line has been opened between this place and Hornellsville.

SANTA FE, N. M.—The New Mexico Automatic Telephone Company has been incorporated. Incorporators, W. M. Berger, Frederick Muller, L. B. Prince, J. H. Blain and Joshua F. Grozier. Capital stock, $2,000. Principal office at Santa Fe.

ADRIAN, MICH.—The Adrian Telephone Company is building a line to Rome Center, Springville and Onsted, and a line from Toledo by way of Fayette, Wauseon and Morenci will be ready for use shortly.

EXCELSIOR SPRINGS, MO.—The Enterprise Telephone Company has been incorporated by J. C. and C. H. Coopinger, R. W. Hood and others. Capital stock, $3,000.

BEAUMONT, TEX.—R. H. Wentworth and others have petitioned for a franchise to establish telephone systems, etc.

HARTSVILLE, ALA.—A telephone line has been established between this place and Danville.

GLEN, N. Y.—A telephone line between this place and Amsterdam has been completed.

Electric Light and Power.

OCALA, FLA.—The Ocala Electric Light Company has applied for a charter, with the following incorporators: S. Dana Greene, Henry M. Francis, John F. Farrell, Albert Wright and J. C. Norcross; with the following officers: S. Dana Greene, president; Albert Wright, vice-president; Henry M. Francis, secretary and treasurer. Capital stock, $20,000.

DE FUNIAK SPRINGS, FLA.—William Rogers and others are interested in the incorporation of a company to build and operate a water and electric light plant. The capital stock of the company will be $10,000, and work will commence on the plant as soon as a charter for the company is received from the state.

COMFORT, TEX.—An electric light plant will shortly be in operation.

WILLIAMSPORT, MD.—City Clerk may give information concerning electric light plant.

REEVES MILL, N. J.—Electric light company near Pitman Grove is negotiating for lease of several acres of meadow land for construction of a dam to increase its water-power.

BARNESVILLE, MINN.—Address City Clerk concerning establishment of an electric light plant.

TULLAHOMA, TENN.—An electric light plant is being established.

CUMBERLAND, WIS.—An electric light plant is to be put in operation.

ALBANY, N. Y.—Electric light plant will probably be established.

BRISTOL, R. I.—The Bristol County Gas and Electric Lighting Company will establish an electric light plant.

HORNELLSVILLE, N. Y.—The Kerr Salt Company at Rock Glen, one of the largest plants in the county, has put in an electric light plant of its own, and will use 200 lights.

DEXTER, MICH.—A system of electric lights will be put in at this place.

MONTREAL, P. Q.—The Royal Electric Company have secured the contract for an electric lighting plant for the town of Fort William. The same company will also light the town of Maisonneuve for a term of two years.

BESSEMER, ALA.—H. G. Meumann will erect a plant for electric lighting, and has applied for a city franchise.

LANSINGBURGH, N. Y.—It is proposed to make extensive improvements to the Beacon Electric Company's plant.

CANANDAIGUA, N. Y.—Mr. Alex. Davidson is talking of organizing an incandescent lighting company. His plan is to locate the plant in the old Johnson & Crowley planing mill property at this place.

WATERLOO, WIS.—The order for an electric light plant, etc., has been let by M. J. Rood & Son. The work is to be completed December 1.

HAMILTON, OHIO—The East Hamilton Electric Light and Power Company has completed their plant, and will furnish electric power to the Mosler Safe Works and the Herring, Hall-Marvin Safe Company. They will also light up the streets of East Hamilton.

SAN FRANCISCO, CAL.—A new electric light plant has just been completed at the State Home for Feeble-Minded Children at Glen Ellen.

MOBILE, ALA.—The Electric Lighting Company is making extensive repairs to machinery.

JACKSONVILLE, FLA.—The Jacksonville Electric Light Company will have lights and power in operation again shortly.

WINSTON, N. C.—The big electric plant on Yadkin River, 13 miles from Winston-Salem, N. C., is well under way, and will be in operation next February.

YORKVILLE, S. C.—The city has completed arrangements for the erection of an electric light plant.

BERRIEN SPRINGS, MICH.—The old Berrien County Court at this place will soon be lighted and heated by electricity and will be converted into a Summer resort.

INDIANAPOLIS, IND.—Gas, City Water and Light Company has been incorporated. Capital, $6,000.

MARQUETTE, ILL.—An electric light plant is being put in at this place. It is said that besides lighting Marquette and the mine there, it will be wired to Seatonville and Depue, to be used in lighting these towns.

New Electric Railways.

VINCENNES, IND.—An electric line is to be built from this place to East St. Louis, Ill. Articles of incorporation have been filed with the Secretary of State of Illinois. The right of way is now being secured. The citizens of this place are interested.

SYRACUSE, N. Y.—An electric railway will be built from this place to Skaneateles.

ROYERSFORD, PA.—A project is well under way here for the organization of the Royersford & Trappe Electric Railway Company, which proposes to connect with the Schuylkill Valley Traction Company at Collegeville. The company will probably mean trolley and electric light for Royersford. The terminus of the line will be at the old toll-gate at Collegeville. The proposed capital stock is $75,000.

WEST SUPERIOR, WIS.—The Superior Rapid Transit Company will wait until the opening of Spring before relaying its tracks with larger rails and to a standard gauge.

DAHLONEGA, GA.—Surveys are being made for an electric railroad line which will probably be built from Dahlonega to Gainesville, a distance of 20 miles.

PARKERSBURG, W. VA.—The Mayor will give information concerning construction of electric railroad, for which a franchise has been granted to syndicate of local parties.

NEWPORT, R. I.—The Middletown & Portsmouth Railroad Company has been organized with a capital stock of $200,000. The road is to be a trolley system, connecting Newport and Fall River.

LANSING, MICH.—Articles of incorporation will shortly be filed for the Lansing, St. John & St. Louis Electric Railway, with a capital stock of $250,000. Mt. Pleasant citizens want the road extended there.

CANTON, OHIO—Canton-Alliance Electric Railway Company has been granted a franchise by the Stark County Commissioners, to run a line from this place to Alliance, via Louisville and Maximo.

PITTSBURGH, PA.—The West End Traction Company has been incorporated; incorporators, J. C. Reilly, W. J. Burns, Thomas S. Bigelow, J. D. Callery, W. V. Callery. Capital stock, $15,000.

PLYMOUTH, MASS.—Messrs. William H. Brine, Horace B. Taylor and William B. Arnold will petition the legislature for incorporation to build and operate an electric road from this place to Sandwich through Bourne, to carry passengers, freight, mails and express.

DES MOINES, IOWA—The Des Moines Street Railway Company is again contemplating an extension of the system to Valley Junction.

New Incorporations.

SAN FRANCISCO, CAL.—The Electro-motor Sign Company has been incorporated by Joe E. Shearer, John L. Cahill, Jason W. Nash, George L. Cahill, and S. W. Robertson. The capital stock is $500,000.

PITTSBURGH, PA.—The Safety Conduit Company has been incorporated; capital, $10,000. The directors are Robert Garland, of Wilkinsburgh; William A. Hodkinson and Franklin C. Hodkinson, of Pittsburgh.

Increase of Capital.

HARTFORD, CT.—The Branford Electric Company has increased its capital stock from $40,000 to $85,000.

Good fiction and abundant and novel illustrations are the features of the Christmas number of *Scribner's Magazine*. The cover is an odd and effective design in color by Maxfield Parrish, a young Philadelphia artist, who has shown wonderful skill in decorative pictures.

Kindred.... ...Interests

The manufacturing capacity of the plant of the American Carbon Company, Noblesville, Ind., is to be increased from 140,000 to 200,000 carbons per day.

Patterson, Gottfried & Hunter, Limited, New York, makers of special machinery and the Fairbanks-Morse gas engine, have circulated a little advertising puzzle.

The A. L. Bogart Company, successors to the business carried on for so many years under the name of A. L. Bogart, so well known in the electrical field, are very centrally located at 50 East Twentieth street, New York. This company controls many valuable features for the electric gas lighting systems.

A dry battery, to be known as the "New Standard," is about to be introduced by William Roche, 259 Greenwich street, New York. Mr. Roche has been for many years identified with the manufacture of dry batteries, and it is thought that with his knowledge of the requirements he is likely to produce a battery which will become universally recognized.

Thirteen thousand horse-power in orders for boilers were received on November 19 by the Aultman & Taylor Machinery Company, of Mansfield, Ohio; 7,000 horse-power of these orders were for the Cahall vertical type and 6,000 horse-power for the Cahall-Babcock & Wilcox type. This is claimed to be the biggest single day's business that has ever been done by any boiler manufacturing concern since water-tube boilers were first invented.

As familiar as is "turkey and cranberries" at Thanksgiving, it is not more familiar than "Okonite" to the electrical interests. Turkey and cranberries is a combination which has won its position because it so successfully satisfies the inner man; "Okonite" has won its position because it so successfully satisfies the requirements for electrical insulations. The idea is perhaps better elaborated by the illustrated page advertisement in this issue.

One of the most attractive and unique advertising novelties that have reached the ELECTRICAL REVIEW office has been received from Mr. H. I. Ireland, 925 Chestnut street, Philadelphia. It represents a pocket in a vest. The pocket contains advertising matter sent out by Mr. Ireland, who is a designer and writer of advertisements. Inserted in the pocket referred to is a booklet containing examples of Mr. Ireland's work for prominent advertisers. All the advertisements quoted are remarkable for their unique and artistic qualities.

In an interview with Mr. F. E. Dolbier, manager of the arc lamp sales department of the General Incandescent Arc Light Company, of New York city, he stated that the continued and increased success which they are meeting in the sale of their inclosed arc lamp denotes the popularity of their product and the satisfactory service obtained by its use. He mentioned, among others, that they had just closed a contract for the installation with their Bergmann inclosed arc lamp, in the new addition of Bloomingdale Brothers' dry-goods store in New York city.

During the past months the Keystone Electrical Instrument Company have made rapid strides in introducing this excellent line of switchboard instruments which have been on the market for many years. The primary reason for this is that the president of this company, Mr. J. F. Stevens, devoted several years of close laboratory work in perfecting the original "Keystone" instruments until every detail, electrically, mechanically and scientifically, should meet the approval of critical experts. Then the mercantile side was pushed vigorously, and the idea of educating electricians to an appreciation of the apparatus—apparatus which is perhaps the most delicate and important in construction work—with increasing success. This company's offices and works are at Ninth street and Montgomery avenue, Philadelphia.

An improvement in the manufacture of Packard lamps has recently been perfected which makes the Packard lamp now a practically smokeless lamp. The improvement produces a lamp which is practically undimmed to the end of its life. There is absolutely no perceptible blackening of the globe even during a life of 800 to 1,000 hours. The improved process is being rapidly applied to all of the lamps made by the Packard Company, and their entire product will soon be made up of smokeless lamps, which will give better results than have ever been secured by any other lamp in actual service. The Electric Appliance Company, of Chicago, the general western agents for the Packard lamp, have been making some interesting tests along this line, and report that the new lamp is a wonder. The trade will soon have an opportunity to determine for themselves the merits of the smokeless lamp by comparative tests of their own, and it is believed that the results will be very largely in favor of the Packard lamp, and the Electric Appliance Company are looking for a very largely increased business.

COLUMBIA CALENDAR FOR 1898.

For the thirteenth year the Columbia pad calendar makes its appearance promptly on time for 1898, and while its general style is of the same familiar character, the many bright thoughts it contains, contributed by its friends in many parts of the country, as well as abroad, are new, and will be appreciated by all who take an interest in bicycling, healthful exercise and good roads. The moon's phases are indicated in the calendar for the benefit of those who wish to have this information. The calendar is ready for distribution, and all orders for it will be filled upon the day of receipt. It can be obtained by mail, prepaid, for five two-cent stamps by addressing the Calendar Department of the Pope Manufacturing Company, Hartford, Ct.

Do You Love Music?

If so, secure one of the latest and prettiest Two-Steps of the day, by mailing *Ten Cents* (silver or stamps) to cover mailing and postage, to the undersigned for a copy of the

Big Four Two-Step.

(Mark envelope "Two-Step.")

We are giving this music, which is regular *fifty cent* sheet music, at this exceedingly low rate, for the purpose of advertising and testing the value of the different papers as advertising mediums.

E. O. McCORMICK,
Passenger Traffic Manager,
"BIG FOUR ROUTE,"
CINCINNATI, O.

Mention this paper when you write.

McINTIRE'S PATENT
CONNECTORS AND TERMINALS.
Special Connectors for HARD-DRAWN COPPER WIRE, *All Sizes.*
Fused Wire, Fused Links and Strips.
The C. McINTIRE CO., 13 & 15 Franklin Street,
Newark, N. J.

Good Telephone Books.

"PRACTICAL INFORMATION FOR TELEPHONISTS,"
BY THOMAS D. LOCKWOOD.
The Telephone Man's Text Book.
192 Pages. Price, $1.00.

"TELEPHONES, THEIR CONSTRUCTION AND FITTING,"
BY F. C. ALLSOP.
Description of Receivers, Transmitters, Switch Boards, Complete Instrument Switches and Switch Boards, Erecting Telephone Lines, Overhead Wires, Instruments, Connecting, Testing for and removing faults.
256 Pages. Illustrated. Price, $2.00.

"TELEPHONE LINES AND THEIR PROPERTIES,"
BY W. J. HOPKINS.
Contents: Design and Construction of City Lines.
Underground Work.
Long Distance Lines.
Wire, Insulators, Exchanges, Switch Boards.
The Propagation of Energy.
The Telephone Current.
Measurement.
Properties of City Lines, Cables, Etc.
Price, $1.50.

"MANUAL OF TELEPHONY,"
BY W. H. PREECE AND ARTHUR T. STUBBS.
Price, $5.50.

"ELECTRIC TELEPHONY,"
BY E. J. HOUSTON AND A. E. KENNELLY.
New. Price, $1.00.

"HOW TO MAKE AND USE THE TELEPHONE,"
BY GEO. H. CARY.
The purpose for which this book is written is to furnish information to those who may desire to construct or use telephones, telephonic apparatus or lines on a small scale.
Price, $1.00.

"TELEPHONE TROUBLES AND HOW TO FIND THEM."
BY C. R. HASKINS.
A practical little treatise for telephone inspectors, exchange managers, and employés who are not electrical experts, as well as the general public, who use telephones or private lines.
Price, 25c.

"THE TELEPHONING OF GREAT CITIES,"
BY A. R. BENNETT.
Price, 50 Cts.

"THE PRACTICAL TELEPHONE HAND BOOK,"
BY J. POOLE.
Price, $1.00.
A thoroughly practical manual of moderate size and cost, describing the latest development of the subject.

"TELEPHONE HAND BOOK,"
BY H. L. WEBB.
Price, $1.00.

Copies of above books sent to any address on receipt of price.

ELECTRICAL REVIEW PUBLISHING CO.,
41 Park Row. NEW YORK.

ELECTRIC CONDENSERS.
WM. MARSHALL,
Manufacturer.
STANDARDS A SPECIALTY.
109 LEXINGTON AVENUE. NEW YORK.

J. C. WHITE & COMPANY,
Incorporated,
ENGINEERS, CONTRACTORS.
Successors to White-Crosby Company, and J. G. White & Co.,
29 BROADWAY, NEW YORK, N. Y.
Baltimore Office, Equitable Building.

ELECTRICAL TRADE SALE.

It will be an Electrical Show—and the biggest kind of a Trade Sale besides. THINK OF IT! Madison Square Garden filled with Steam and Electrical Machinery and Supplies—and more buyers and sellers and lookers than you ever saw together anywhere. What would it cost you to reach all these people in the usual trade way? Whatever it would cost, you will save most all of it, if you have an exhibit in the Electrical Show.

Space is being rapidly taken. It is suggested that firms interested act with as little delay as possible.

ELECTRICAL EXHIBITION COMPANY,
15 Cortlandt Street, New York City. MARCUS NATHAN, General Manager.

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED NOVEMBER 16, 1897.

593,819 Telephone and signaling or calling system; J. G. Smith, New York, N. Y.

593,820 Signaling or calling system; J. G. Smith, New York, N. Y.

593,832 Electric brake for elevators; J. P. Casey, Bloomsburg, Pa.

593,847 Trolley; O. L. Kirsch, West View, Pa.

593,852 Multiple metering of electric currents; E Oxley, Washington, D. C.

593,853 Electric cut-out; H. T. Paiste, Philadelphia, Pa.

593,858 Indicator for electrical measurements; E. B Rosa, Middletown, Ct.—An apparatus for recording instantaneous values of electric quantities, the combination with an instantaneous-contact maker having a brush to move periodically, of a recording surface adapted to move in synchronism with said brush, and means for recording the electrical values on said surface.

593,877 Igniting device for gas or like motors; Albert DeDion, Puteaux, France.

593,884 Electric annunciator; J. A. Gowans, Stratford, Canada.

593,899 Electric arc lamp; G. R Lean, Cleveland, Ohio—The combination with an arc-inclosed alternating-current arc lamp, of cored carbons, the cores of which are one-sixteenth of an inch in diameter or less.

593,914 Electric switch; W. M. T. Weise, Davenport, Iowa.

593,919 Electrical switchboard for coin-operated machines; J. L. Bludgett, Los Angeles, Cal.

593,945 Driving gear for motor cars; Ferd. Kramer, Cologne, Germany.

593,956 Street and station indicator; S. E. Bisbee, South Pasadena, Cal.

593,962 Telephone toll apparatus; Wm. Gray, Hartford, Ct.—In combination with the receiving and transmitting part of a telephone apparatus, a metallic channel plate supporting a signal device, a metallic post supporting a transmitter and a metallic connection uniting the transmitter post and the channel plate.

ISSUED NOVEMBER 23, 1897.

593,981 Apparatus for electrically heating metals and ores; Geo. D. Burton, Boston, Mass.—In an electric metal-heating apparatus, the combination of a hearth, an electrolytic solution therein, holders for holding blanks to be heated on said hearth, and means for pressing said blanks together, said blanks being connected with one electric pole and the liquid with the other.

593,984 Trolley; R. W. Clarke, Victoria, Canada.

593,988 Resisting device; G. K. Cummings, Chicago, Ill.—In an electrical resisting device, the combination with cross-pieces of the terminal rods supported on said cross-pieces, two of the said cross-pieces being movable, a number of tubes containing electric resistance material of constant density supported between the movable cross-pieces, and means for adjusting the tubes on some of the terminal rods.

594,034 Automatic circuit-controller; C. W. Prince, Newark, N. J.

594,036 Roentgen-ray tubes; H. L. Sayen, Philadelphia, Pa.—As a means for varying the pressure in a high-vacuum tube, a main circuit for operating the tube and a shunt-circuit for varying the pressure.

594,051 Electric battery; D. S. Williams, Philadelphia, Pa.—A conductor and support for the active material of a battery electrode formed of a single sheet stamped or cut out and then bent transversely upon itself in such a manner as to form a series of superposed channeled plates united by integral-yielding conducting strips.

594,060 Telephone; T. Berdell, New York, N. Y.

594,122 Indicator for underground electric railways; H. C. Reagan, Jr., Philadelphia, Pa.

594,131 Bell extension for telephones; E. S. Dickerson, Philadelphia, Pa.

594,143 Regulating Roentgen-ray tubes; M. J. Rice, Schenectady, N. Y.—An automatic vacuum adjuster for Roentgen-ray tubes, consisting of a shunt-circuit, including in the path of the current a volatile salt within the vacuum inclosure, and a high-resistance in lieu of the spark-gap.

594,144 Regulating or alternating-current system; C. P. Steinmetz, Lynn, Mass.—The combination in an alternating-current system of a source of out-of-phase of current or electromotive force between the feeding mains and a working sub-circuit or branch of the system, and a phase modifier in such sub-circuit.

594,145 Inductor dynamo; C. E. Steinmetz, Schenectady, N. Y.—An inductor dynamo, comprising a revolving inductor and a stationary armature, the latter having portions of laminated iron and a solid yoke, with an auxiliary or additional air-gap in the armature iron.

594,150 Starting device for alternating-current motors; W. J. Foster, Schenectady, N. Y.—As a means for increasing the starting torque of a synchronous alternating-current motor, a bridge of magnetic material adjacent to the polar face of the induced member.

594,155 Section insulator; J. Hoffman, Schenectady, N. Y.

594,156 Roentgen-ray tube; I. W. Howell, Newark, N. J.—A vacuum tube having in shunt to the main discharge-path, a second discharge-path through a gas-producing agent in the same vacuous space with the main discharge-path, and serving to regulate the vacuum in the bulb.

594,192 Automatic burglar-alarm; J. W. Baughman, Dalton, Ohio.

594,227 Electric switch; A. C. Brockies, London, England.

594,247 Electric cable; J. D. Gould, Brooklyn, N Y.—An electric cable, comprising a fossible core, an insulating material covering the same, a series of conductors wound spirally around said insulating material, and an insulated cord wound between adjacent spirally-wound conductors.

594,256 Electric railway signal and safety device; K. Kohn, Seward, Neb.

594,281 Automatic signaling system; C. W. Price, Newark, N. J.

594,300 Railway signal; J. D. Taylor, Chillicothe, Ohio.

594,306 Electric time switch; A. B. Williams, Waco, Tex.

594,313 Storage and secondary battery; R. Ashley, Fort Republic, N. J.—An electrode for a storage or other battery consisting of the horizontal, straight and corrugated metal strips alternating with each other, and the spacing pieces between the ends thereof and soldered thereto.

594,338 Motor carriage; R. E. Olds, Lansing, Mich.

594,346 Heat-regulating apparatus; C. E. Fortier, Milwaukee, Wis.

594,363 Telephone system; A. F. Swan, Bayonne, N. J.

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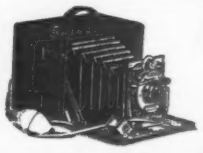

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(Concluded from page 289.)

ment until the steel produced possesses both in a striking degree.

Fig. 2 shows an interior view of the shop, that side devoted to the milling machines, gear cutters, key-seating machines, special drill presses for drilling the bolt holes in the gears and others. Some idea of the extent of the industry may be gathered from the number of gears in the foreground standing ready for shipment on order or removal to the stock room. Fig. 3 is a nearer view of some of the special drill presses, milling machines, etc., with a lot of gears in course of preparation for the teeth-cutting machines.

The process of manufacture of a pinion is illustrated in Fig. 4, showing the pinion forging, the pinion blank, milled, bored and seated, ready for the teeth to be cut, and the finished pinion ready to ship. Fig. 5 shows a steel gear, bolted together and machined, with part of the teeth cut. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive experiment. The machines used are both elaborate and expensive, and are of unusually heavy design and accurate workmanship. They are all fitted with ingenious devices for producing uniform teeth. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. All, that is both pinions and gears, undergo a rigid inspection before shipment.

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life and the proper economical life. There is a point in the age of gear and pinion at which it becomes more economical to consign them to the scrap heap and to use a new gear and pinion, than to retain them in service. The question is a nice one, and a series of efficiency tests have recently been carried out. While the results are not yet collated, it may be said that a worn gear and pinion requires some 400 watts more energy than a new gear and pinion. This is a statement made authoritatively, and one which will give food for profitable thought to managers of electric railways.

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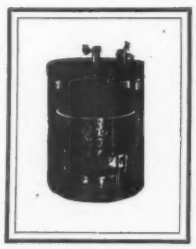

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